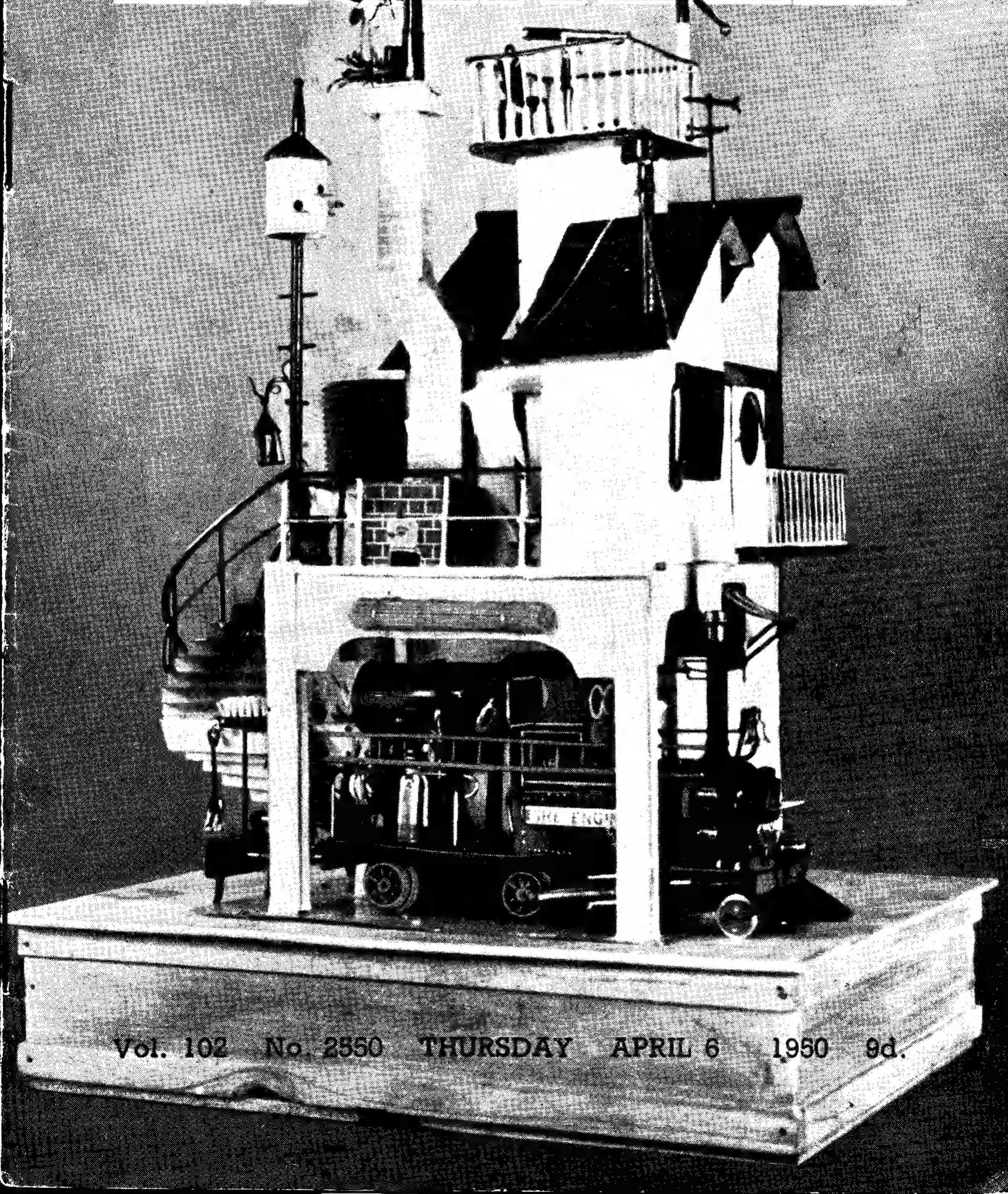
THE MODEL ENGINEER



Vol. 102 No. 2550 THURSDAY APRIL 6 1950 9d.

The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

6TH APRIL, 1950 VOL. 102 NO. 2550

Smoke Rings	455
That Mystery Cruiser Again !	457
A "Cutty Sark" Model	460
Petrol Engine Topics—Modern Ignition Developments	461
Old Ploughing Engines	464
A 1½-litre HRG Sports-type Car	467
"Pamela," A 3½-in. Gauge Rebuild of a Southern Pacific	470
Novices' Corner	474
Mounting Work on the Lathe Cross-slide	474
A Simple Scribing Block	476
In the Workshop	477
Building the ⅜-in. Cowell Drilling Machine from Castings	477
A Model Overtype Engine	483
Twin Sisters	484
Height Gauge with Adjustable Base	488
Queries and Replies	489
Practical Letters	490
Club Announcements	492
"M.E." Diary	493

SMOKE RINGS

Our Cover Picture

● THE MODEL engineer who does not possess a sense of fun is a very dull person ; but it is not very often that even our humorists—and we know quite a few—allow themselves to vent their exuberance in constructing something purely fantastic. Mr. Frank Roberts, of Auckland, New Zealand, however, is one of the few who have amused their friends and themselves by applying their creative gifts to a sheer flight of fancy. The concoction created by Mr. Roberts is illustrated on the cover of this issue ; he calls it a "Heath-Robinson" signal-box, and we think it thoroughly deserves the title !

The locomotive is for 1¾-in. gauge, but has no motor at present. Its duties cover those of fire engine, shunting engine, ambulance and steam heating for the signal-box. Since the photograph was taken, the engine has been fitted with an automatic elevating tablet exchanger which, incidentally, brings up the milk in the morning !

As can be seen, the lavatory is equipped with a periscope, and we understand that it also has an extension telephone and other amenities. To us, the building would seem to present a problem to estate agents who might be looking for alternatives to the phrase "this desirable residence" !

The Model Railway Exhibition

● AN EVENT which readers are advised not to forget is the Model Railway Exhibition which will be held at the Central Hall, Westminster, S.W.1, from April 11th to the 15th. The times of opening will be : 2 p.m. to 9 p.m. on the first day and 11 a.m. to 9 p.m. on each of the following days. This annual show has become the principal highlight of model railway activities, and there is always plenty to be seen and admired. The exhibits range from complete working model railways down to the smallest accessory, and number, altogether, something like 3,000 separate items. Special terms are available to organised parties of visitors ; application for fuller details should be made to Mr. R. C. Panton, 162a, Strand, London, W.C.2. It is a show which should never be missed by anybody interested in railways, miniature and full-size.

The Sheffield Exhibition, 1950

● AMONG THE large number of exhibitions being organised in the early part of this year is the one by the Sheffield and District Society of Model and Experimental Engineers. This important event will take place at the Central Technical School, Leopold Street, Sheffield, on April 12th to 15th inclusive. The times of opening will be 2 p.m. to 10 p.m. Wednesday to Friday, and 10 a.m. to 10 p.m. on the Saturday. A large and comprehensive display is being arranged, and the competition section will be, as usual, the principal feature.

An Historical Model Railway Society

● A PARTY of about thirty people met in very congenial surroundings at the restaurant in the grounds of Chessington Zoo, on March 18th, to discuss a most interesting proposition put forward by Mr. R. G. Dettmar, of Ashtead. Now that the individuality of the British railways has ceased to exist, the time seems opportune to bring into existence a society or association which shall have as its prime object, the collation and dissemination of all kinds of information about the railways as they used to be. Although such information would, naturally, interest anybody who makes a study of railways and their history, the idea of the new society is that the information shall be collected into a centralised source, chiefly for the benefit of railway modellers.

The scheme was unanimously approved by the meeting at Chessington, and a provisional committee was appointed for the purpose of drawing up a proper constitution and to define the aims and objects of the new society.

Meanwhile, anyone interested in the idea is invited to send his name and address to Mr. R. G. Dettmar, c/o R. G. Dettmar & Co., Ashtead, Surrey.

The Cost of a Hobby

● SOME VERY interesting and well-executed examples of ornamental turning were displayed at a recent model engineering exhibition, and on a card beside them was a reference to the type of lathe on which they were produced. It was stated that a fully-equipped ornamental turning lathe would be valued today at a sum running well into four figures. The truth of this is not disputed ; the best examples of such lathes which were made during last century are marvels of ingenuity and fine workmanship, and the specimens of them which remain in good condition are extremely valuable, while it is doubtful if new lathes of this type could be obtained nowadays, even to special order. Nevertheless, the statement was rather misleading, and appeared to be somewhat indiscreet as the accompaniment to a show of work, at an exhibition in which an important object is to attract newcomers to take up the hobbies represented. Ornamental turning can be, and very often is, executed with the very simplest equipment, and any small lathe fitted with a slide-rest can be adapted to turn out a wide and varied range of work by the addition of simple attachments. Even the more elaborate devices for ornamental turning, such as geometric and eccentric chucks, are not beyond the ingenuity of the lathe user, and we have seen many examples of highly complex work turned out with entirely home-made supplementary lathe equipment. We doubt whether there are likely, at the present day, to be many recruits to a hobby in which the necessary equipment would cost more than a thousand pounds ; and to draw attention to the matter of expense of such a hobby, even in an indirect way, appears to be very dubious propaganda. There is no doubt whatever that ornamental turning, once the hobby of nobility and even royalty, well deserves the attention of ingenious and painstaking craftsmen, and we should like to see more attention devoted to it ; but we think that demonstrations of the kind of appliances which can be made or adapted for the purpose by the impecunious beginner, would be the policy most likely to attain this end.

A Norwich Revival

● WE HAVE been advised that the Norwich Society of Model Engineers has decided to hold an exhibition this year, for the first time since 1938. This is welcome news because, in spite of all that has happened in the meantime, we believe that most of the members have been busy in their workshops whenever opportunity permitted.

The dates of the exhibition will be October 26th to 28th next ; but the society is particularly anxious that all cups which were awarded at its 1938 exhibition shall be returned to the hon. secretary, Mr. J. Powell, 29, Spinney Road, Thorpe, Norwich, as soon as possible.

More News from Old Oak Common

● WE HAVE received a letter from Mr. S. G. Hickmore, hon. secretary of the club, telling us that the name of the Old Oak Common Model Engineering Club has been changed to *The Acton Model Engineering Society*. This change has been made to get rid of the impression that, because the club held its meetings and had its facilities on the premises of British Railways (Western Region) Locomotive Depot at Old Oak Common, it was open to British Railways staff only. Any model engineer in the district can join, if he wishes.

We are very glad to learn that one of the members Mr. C. H. Smith, has been successful in arranging that the basement in the shop where he is employed can be used as a temporary workshop. This has had the effect of considerably stimulating the activities of the members. The equipment, so far, consists of a 2-in. Wade lathe presented by Mr. Holtorp, a drilling machine and three bench vices ; it is hoped to increase this equipment very soon.

The main interest of members, at present, is model railways from "OO" to 3½-in. gauge. Four members are building a "OO"-gauge layout so that those members who have not the space at home, will be able to build rolling-stock and run it. A multi-gauge track will be under construction as soon as the materials can be obtained.

From this, it is evident that very favourable progress is being made ; but, Mr. Hickmore writes, any persons interested in any branch of model engineering will be heartily welcomed. His address is : 106, Milton Road, Hanwell, W.7.

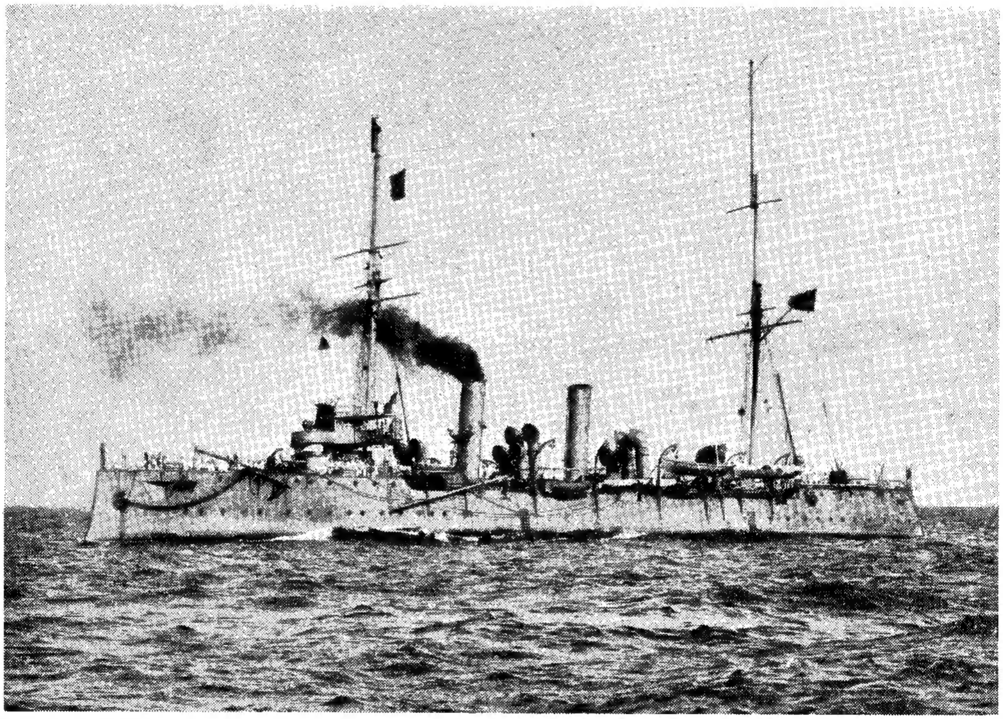
That Mystery Cruiser Again !

by W. J. Hughes

IN reality the heading to this article is a misnomer, because it seems that the mystery is a mystery no longer ! The notes at the end of this article by Mr. C. W. E. Richardson give many well-founded reasons for his belief that this model is the original design for the " P " class of light cruiser, which was subsequently modified in detail when building. I may say at once that Mr. Richardson is a great authority on naval vessels of all types and periods, but he has modestly forbidden us to say anything about him —in fact, he may chew me up for saying as much as I have done.

However, Mr. Richardson's opinions are shared by other readers who have been kind enough to write either to the Editor or to me direct, and I now propose to deal briefly with these letters, since space does not permit them to be printed in full.

But first I am reproducing a photograph of H.M. Cruiser *Pegasus*, one of the " P " class built by Palmers, and the reader can check for himself how accurate are Mr. Richardson's beautiful drawings. He can also compare it with the photographs of *Rainbow* and the model published with my original article (December 23rd, 1948), and he will then realise, perhaps, how a non-naval man like myself did not connect the two. Where I went wrong, of course, was in assuming that



H.M. Cruiser " Pegasus "

the model was of a prototype *as built*, and thus in limiting my search in Palmer's catalogue to vessels built up to 1891. Still, I *did* manage to deduce that the prototype of the model was not as large as *Rainbow*, and I *did* get the size right !

I must say that I agree with Mr. Richardson's deductions (as one can hardly fail to do), and so do other correspondents, so let us deal with them.

The first letter was from Mr. H. R. Vidler, of Mill Hill, London, who wrote : " The article . . . so interested me that I forthwith set about searching through all available naval records in an attempt to identify this intriguing old model. I was assisted in this search by a very well informed naval architect, but without any success." (I can thus take comfort that I was not alone in missing the solution to the mystery !—W.J.H.).

beam gun mountings is the same though the positions are different. The underwater shape differs but the elevation given repeats that given in *Fighting Ships* and *Brassey*—the remainder being drawn in after examination of photographs of ships of this class.

In the elevation drawing of the model only what appears on the photographs is shown and, therefore, boats, davits and beam guns are omitted.

Particulars of the "P" class cruisers are as follow :—

Name	*Builder*	*Launched*
Pelorus	Sheerness D.Y.	Feb., 1896
Proserpine	Sheerness D.Y.	Dec., 1896
Pegasus	Palmer	Mar., 1897
Pyramus	Palmer	May, 1897
Perseus	Earle	July, 1897
Psyche	Devonport D.Y.	July, 1898
Prometheus	Earle	Oct., 1898
Pioneer	Devonport D.Y.	June, 1899
Pandora	Portsmouth D.Y.	Jan., 1900

Displacement : 2,135 tons (last two, 2,200 tons).

Length 300 ft., beam 36½ ft. (i.e. practically 8 : 1 ratio), draught 17 ft.

Armament : Eight 4 in. ; eight 3-pdrs. ; two Maxims, two 14-in. T.T.

Complement : 235.

Machinery : Three-cylinder triple expansion, two screws, designed h.p. 7,000 for 20.5 knots.

Cost average £150,000 each.

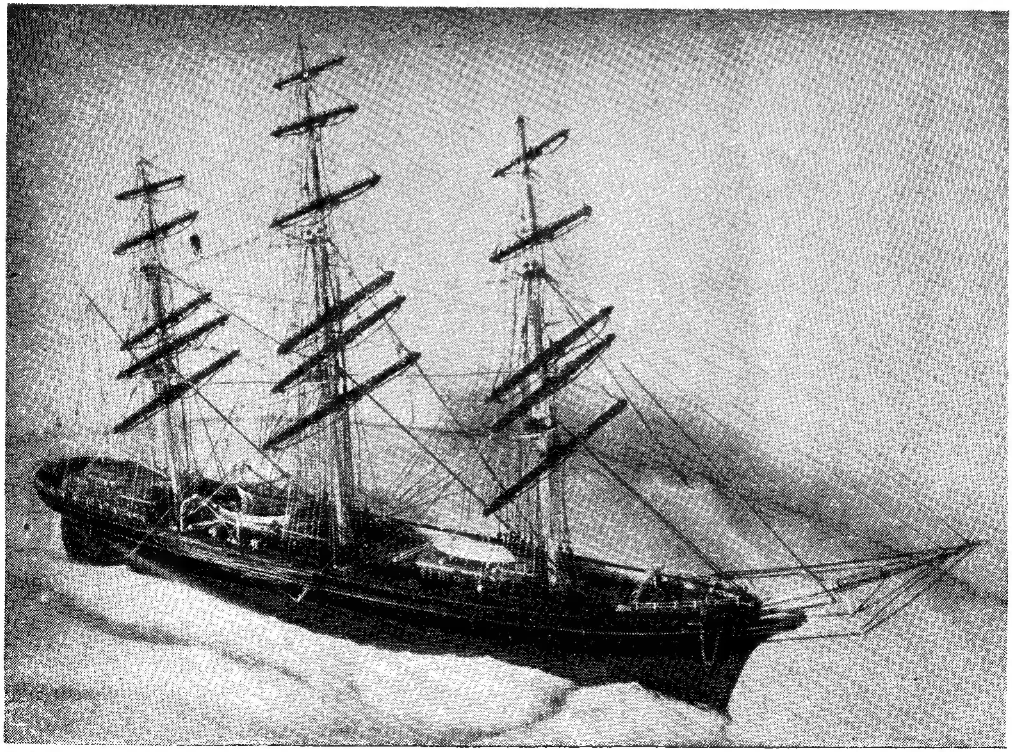
Coal : 250 tons normal but could carry 520-540 tons.

Palmer's vessels were the only ones with Reed boilers, *Pelorus* having Normand and the remainder Thornycroft.

Many of the class removed from Navy List by 1914 but *Pegasus* was sunk by the *Emden* and *Pioneer* was the last to go in 1923 when she was removed from the Australian Navy.

A "Cutty Sark" Model

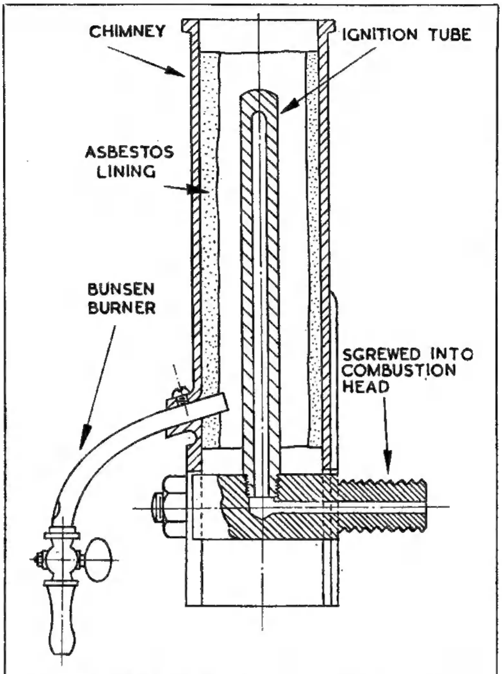
Some time ago we received a set of photographs from Squadron Leader Edwards of No. 2 Officers' Mess, No. 32 M.U., R.A.F., St. Athan, Glamorgan. The photographs included a fine model of the *Cutty Sark*, which we reproduce on this page, a cabin cruiser, a cruising ketch, three galleons, and the very promising hull of a three-decker of the eighteenth century. One of the photographs showed the models grouped for an exhibition which the club had staged. The generally high standard of the models and the variety of types represented showed that there was a keen ship-modelling interest and considerable talent among the members of the club. Perhaps they are now dispersed to the four corners of the earth, but if this should happen to catch the eye of Squadron Leader Edwards, or of any members, we would be glad to hear from them.



PETROL ENGINE TOPICS

Modern Ignition Developments

by Edgar T. Westbury



Section of ignition tube as formerly used on stationary gas engines The chimney and burner are vertically adjustable to control ignition timing

AMONG the many problems in the design of internal combustion engines, few have exceeded in magnitude and complexity those of ignition, and on the face of it, this is not surprising, in view of the exacting conditions which must be fulfilled in order to ensure that ignition takes place with unfailing regularity, and often incredible frequency, with a charge of dubious combustibility, often vitiated with the residue of exhaust gas, and at high pressure and turbulence. In the case of the automobile type of petrol engine, it has long been accepted that the most satisfactory and reliable method of ignition is by means of an electric spark, and when petrol engines were developed in a small size, the same general conclusions appeared to hold good in this case also.

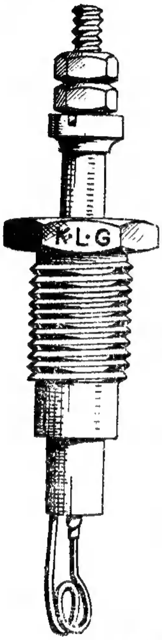
The design and construction of suitable ignition equipment for small engines, however, has always been a serious difficulty, and often a limiting factor, in the success of the small petrol engine, particularly in cases where a high power/weight ratio was called for, and the "dead" weight of even the lightest possible means of producing an ignition spark was a serious disadvantage. It is not surprising, therefore, that the advent of engines which either eliminated the need for any ignition equipment at all, or reduced it to a very simple form which only called for temporary application of electric current, was hailed with enthusiasm by the majority of those interested in the application of the small i.c. engine to high-efficiency models.

I have often been taken to task for my apparent neglect of these modern developments—compression-ignition and glow-plugs—which, I am repeatedly informed, have now entirely superseded the old-fashioned petrol engine. At the risk of being labelled a blimp and a die-hard, however, I do not admit that this is strictly true. There are still many model engineers who, like myself, get far more pleasure in the actual process of constructing engines than in running them, either competitively or otherwise; and though they are nowadays vastly outnumbered by equally enthusiastic *users* of engines who have little interest in construction, I still regard them as the most important people from the purely model engineering aspect.

The elimination of spark ignition makes very little difference to design, and practically no difference at all to constructional methods and problems; therefore it has not been necessary to evolve entirely different engines, and except in points of detail, sound design in spark-ignited engines is equally sound when applied to glow plug or compression ignition engines. In fact, it may be said that many of the early differences in the three types of engines, which in some measure were due to their having been evolved in different countries, are now disappearing, and the engines are becoming very much alike both externally and internally. A petrol engine may become a glow-plug engine simply by omitting any provision for fitting a contact-breaker; and if, in addition, the compression is raised, preferably with the provision of a variable-compression device, such as a contra-piston, it becomes a "diesel."

Many readers do not realise that when small i.c. engines began to attract "big business," many of the special features both in compression-ignition and glow-plug engines, not to mention the glow-plugs themselves, were covered by patents, and as I have a healthy respect for patent law (having been the victim of infringements myself!), I always do my best to avoid offending by "pirating" ideas or features. It is, of

course, very difficult for a patentee to keep track of everyone who poaches on his preserves, and it is generally accepted that making a patented article for one's own use is not infringement in the legal sense, so long as it is not manufactured or marketed. I have a strong suspicion, however, that if a writer describes, in a published journal, how to make a patented article, the patentee may have good grounds for a legal action against him. Considering how many thousands of patents there are in existence in connection with i.c. engines, one is sometimes hard put to it to steer a course between them.



Electric heater plug as used to assist cold starting on large diesel engines

The Glow-Plug Principle

In a way, this may be said to be a reversion to a very ancient principle of ignition, being the reincarnation, in modern guise, of the old principle of using a heated tube or similar surface in a pocket or recess adjacent to the combustion chamber, and usually, but not invariably, in permanent communication with the latter. This method had a short career in automobile practice (where, incidentally, platinum ignition tubes were sometimes used, and presented a potent incentive to early car thieves), and a much longer existence in stationary engines, where ceramic tubes were more common. It was usual to heat the tube to incandescence by means of a bunsen burner or blow lamp before starting, and in most cases it was necessary to maintain the external heating all the time the engine was running.

By placing the tube in a more or less isolated pocket in the head, the premature ignition of the charge on the induction stroke, or the early part of the compression stroke, was avoided, as a pocket of inert gas was interposed between it and the hot surface ; but this was compressed into the tube as the piston advanced towards top dead centre, and ignition took place when the fresh mixture reached the hot spot. Some control of ignition timing could be obtained by varying the depth or volume of the combustion pocket, or the position of the tube on which the heat was concentrated. Variants of this system included the " hot bolt," which was usually of copper, and projected both inside and outside the head, and the " hot bulb," usually employed in connection with fuel injection, and being the logical ancestor of the " ante-chamber " diesel engine. In some cases it was found possible, after once the engine had started, to dispense with external heating, the hot surface being maintained at sufficiently high temperature by the heat of combustion. A few engines were fitted with an ignition valve, with the idea of obtaining more exact control of ignition timing, by establishing communication between the combustion chamber only immediately before firing point.

Most of these devices died a natural death in the first quarter of this century, being displaced either by electric ignition or by compression-ignition, but from actual experience with them, I can testify that they worked well enough within their limitations, and were superseded rather for reasons of convenience than of efficiency or reliability. On very small gas engines, however, the bunsen burner for heating the ignition tube often required more gas than was consumed inside the cylinder. Electric methods of heating were tried tentatively in the early days, but the practical success of the low-tension electric " heater plug " dates practically from the time when it was re-introduced as a means of assisting diesel engines to start from cold. The glow-plug now favoured for small high-performance engines is, in its turn, a direct development of the heater-plug, reduced in size and adapted to specific requirements. But whereas the resistance element or " filament " of the heater-plug projects into the combustion head or ante-chamber, often in the direct path of the spray from the fuel injection valve, the glow-plug, like the old hot-tube igniter, is isolated to some extent from the combustion chamber and for a similar reason, as will be seen presently.

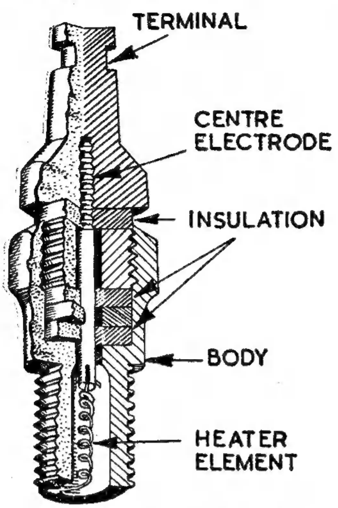
The Modern Glow-Plug

As most readers are well aware, most modern high-efficiency enthusiasts have wholeheartedly discarded electric spark ignition in favour of compression-ignition or glow-plugs, and to these highly sophisticated readers it is quite likely that my elementary description of basic principles will appear somewhat naive. It should, however, be remembered that I am dealing with first principles, and from other aspects than those of purely high-efficiency and high power/weight ratio. Many of my correspondents have asked for advice on the application of the glow-plug, in many cases for engines or fuels to which they are fundamentally unsuited, or for purposes where such plugs are extremely unlikely to be a really practical success.

In these circumstances it is desirable to give a broad description of working principles rather than minute details of the most up-to-date methods or equipment. Some of my correspondents are under the impression that glow-plugs call for the use of a super-high compression ratio, but this is not the case, and constitutes one of the advantages of the glow-plug over compression-ignition. Engines of moderate compression ratio will run quite well on glow-plugs if a suitable fuel is used, and so far as my experience goes, extremely high compression ratios cannot be exploited to advantage to the same extent as with spark ignition. The life of glow-plug engines is generally longer than " diesels " and they usually run smoother, because of lower maximum cylinder pressures and mechanical stresses.

The heating element of the modern low-tension glow-plug is of a highly refractory platinum alloy, and it is enclosed in the cavity of the plug so that it is not only protected to some extent

from the fury of the explosion in the cylinder, but some control over its temperature, and therefore the ignition timing, can be obtained. In common with the principle of tube ignition, the plug cavity forms a pocket of inert gas, and the depth to which the fresh charge can be compressed into it is influenced by the compression ratio of the engine.



Section of a typical glow-plug for miniature engines

For starting purposes, the heating of the element is effected by application of electric current, but when once the engine has started, it is kept hot by combustion temperature ; successful working depends largely on the use of special fuel, ordinary petrol being quite unsuitable in this respect. It is possible to start up an engine with petrol fuel, and it will run on it, so long as the plug is connected to the electric supply, but in nearly all cases will fail to keep running when the current is disconnected.

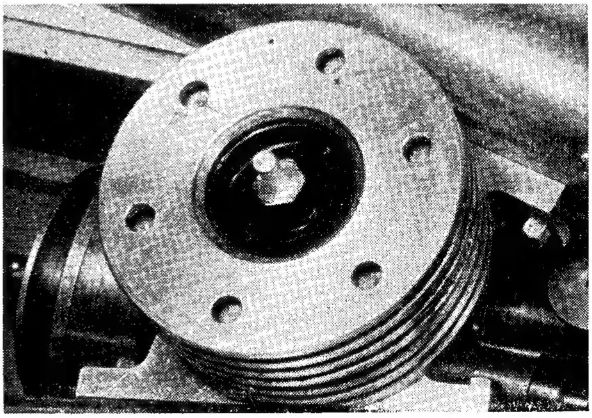
The reason for this is quite logical ; the development of motor fuel has for many years been very largely concerned with the avoidance of self-ignition, such as might possibly be caused by overheated sparking plug points or particles of hot carbon in the cylinder-head. As a result, modern petrol has a very high *ignition* temperature—this should not be confused with *flash point*—and will only ignite when a really hot spark or flame is applied to it. The dull red glow maintained by the glow-plug filament, when not energised with current, is insufficient to ensure certain ignition. No doubt there are exceptions to this rule, and I fully expect to be informed of them ; but it is generally recognised that successful glow-plug ignition is only possible with fuels which have a much lower ignition temperature than petrol.

Glow-Plug Fuels

I do not propose to go into details about these fuels, as it is much easier, and generally more satisfactory, for the user to obtain a ready-made glow-plug fuel than to experiment in compounding his own. Some of the ingredients of these fuels are difficult to obtain, and by no means as safe as they might be to handle ; unless one has a profound knowledge of fuel chemistry, the results are anybody's guess. As the atomic physicist said when demonstrating nuclear fission to a class of students : "If anything goes wrong with this experiment, I shall be blown sky-high. Now, come a little closer, so that you can follow me ! "

The simplest glow-plug fuel is one containing a large proportion of alcohol, such as methanol, (derived from wood alcohol), which may be used alone, except for the admixture of lubricating oil, in the case of two-stroke engines, and as mineral oil will not mix properly with alcohol, castor oil is generally employed. Blends of acetone and other hydrocarbons are also used, and the "super" glow-plug fuels contain small percentages of nitro compounds, which improve their ignition properties and in many cases enable the maximum power output to be obtained.

In many high-efficiency circles at the present day, fancy fuels have become a cult and a ritual ; the man who turns up at the racing track, pond or aerodrome with a bottle of common or garden petrol is liable to lose technical status. Well, every man to his taste—if they get fun out of this sort of thing, good luck to them, and may the best witch's brew win ! But it has always seemed to me that there are practical disadvantages in an engine which will only run on a cocktail or a cough mixture, and I have always considered it desirable to legislate, in my own designs, for the use of simple fuels, the possibilities of which have by no means been exhausted yet. So far as available information goes, the performance of engines with glow-plugs and special

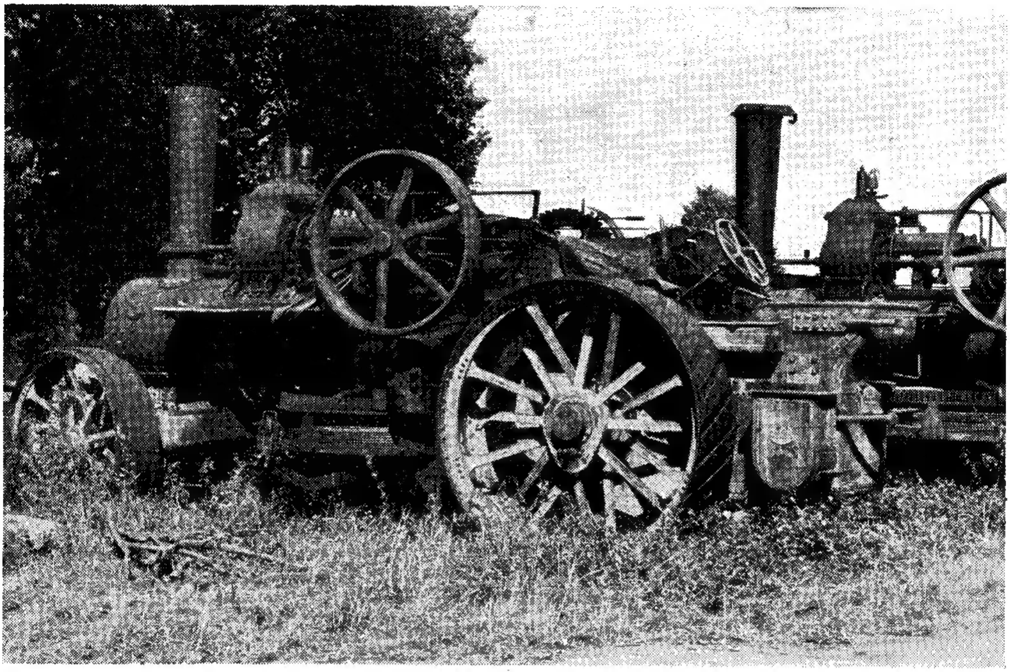


The cylinder-head of Mr. G. Lines' hydroplane "Sparky II," which is fitted with a home-made glow-plug

(*Continued on page* 466)

Old Ploughing Engines

by Henry A. J. Lawrence



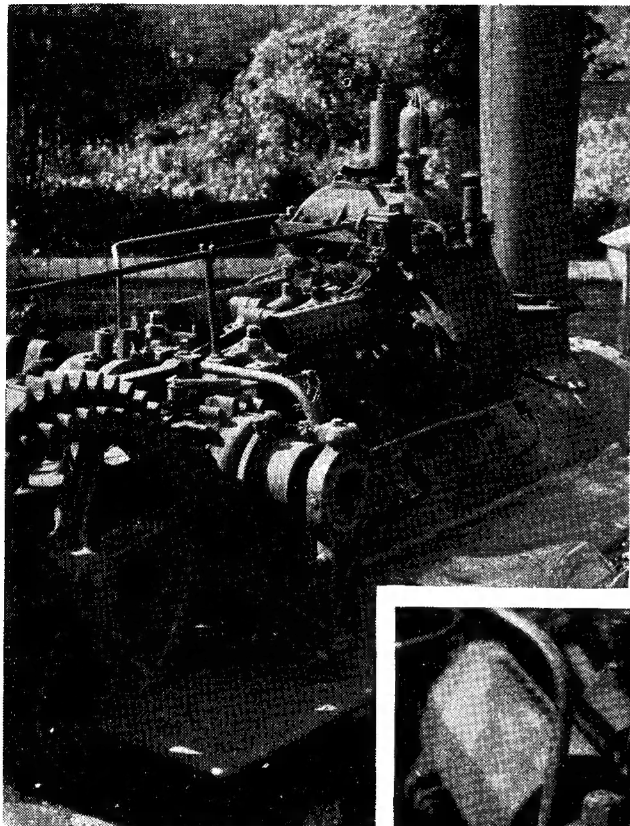
THIS is the story of the meeting of friends. Years ago, motoring near Wellesbourne, in Warwickshire, one morning, I saw in a field two ploughing engines, one at each end of the field. Between them stretched a cable and near one engine was a nightmarish gargantuan monstrosity on which the pigmy figure of a man was seated. I stood on everything in the car, and opening the door, legged it for the nearest hedge. As I came panting up, a thin cloud of steam rose from the engine nearer the Martian death wagon and a second afterwards, a piercing whistle sound came to my ears. Almost instantly a puff of smoke and a snort came from the farther engine and the plough started its bucking journey to the other side of the field. The cable whipped and squirmed like some tortured serpent and great clods of earth spun sideways from the coruscating blades. Over in the far distance the great engine, anchored securely by its massive weight, bucked and rocked and belched its smoke as it tore the great plough through the unwilling earth. I thought of all the fun fairs I had ever seen and realised that they had nothing on the perilous ride of the unfortunate seated on the plough. I stayed a long time watching what was once a barren field turned over to the good brown earth of Warwickshire. But eventually business called and I had to drag myself away from one of the alas ! fast disappearing pleasant sights of the countryside.

Years have passed ; a great war has come and gone and I never saw my engines again. Until—! One weekend last summer I was coming through Charlecote—just at the point where Will Shakespeare was taken for stealing the buck—not passing it ! A high brick wall surrounded a rick-yard and over the top of the wall were visible two tall cylindrical chimneys. With a total disregard of all following traffic (if any), I steered across the road, and hardly waiting for my car to come to a standstill, I grabbed my camera and bolted out of the car. It was only the work of a moment to be through the farmyard doors, and—there they stood as I saw them last—the Twins. There were four or five men in the yard and to them I went, " Could I be allowed to photograph the engines." " Be you from the Press ? " cautiously asked one whom I took to be the foreman. " No," I said, " just a lover of steam."

" Then, take thee coat off," said the man, " and get they two beauties going ! "

" What about your new tractor ? " I countered, indicating a brand new implement of famous make, " Won't that do the job ? "

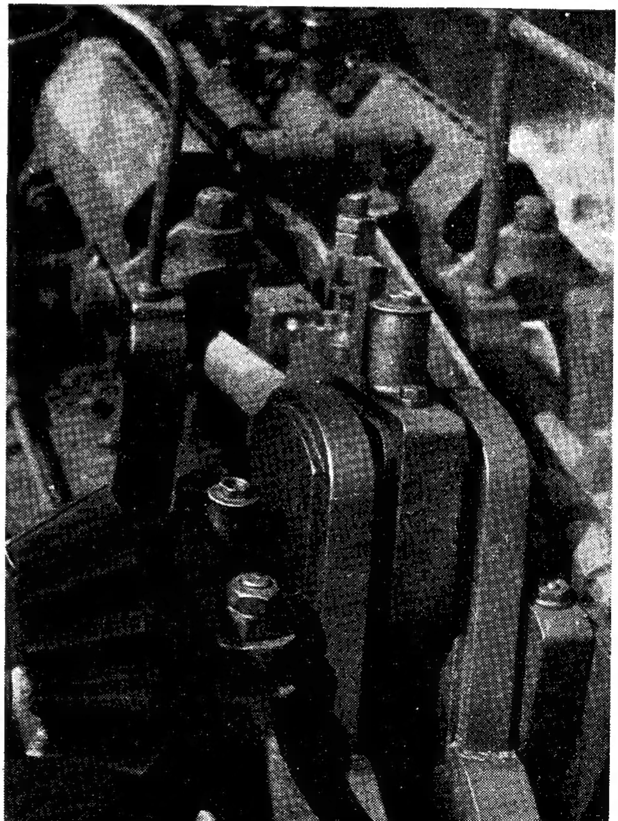
" They ! " he snapped, and spat lugubriously. " They couldn't pull the skin off a rice-puddin'



had been covered with tarpaulins, one of which I pulled aside. There was no rust about them but they looked so forlorn as they stood there in the summer sunshine with the nettles growing up round them. There on their flanks were the plates of cast brass with their maker's name proudly displayed: "John Fowler, Engineers, Leeds," and the number 15218.

I went across to the other engine. There she stood, within whispering distance, and her number turned to her sister, 15219.

For the next hour it was a matter of photography, only the results of which will interest you. But for me it meant clambering up in the cabs and standing on cranks and boiler tops to get a better view, for your, my gentle reader's, edification and benefit. And I hope the glints of sunshine on these wonderfully made and fitted parts will prompt some reader to make a pilgrimage to Warwickshire and to seek out

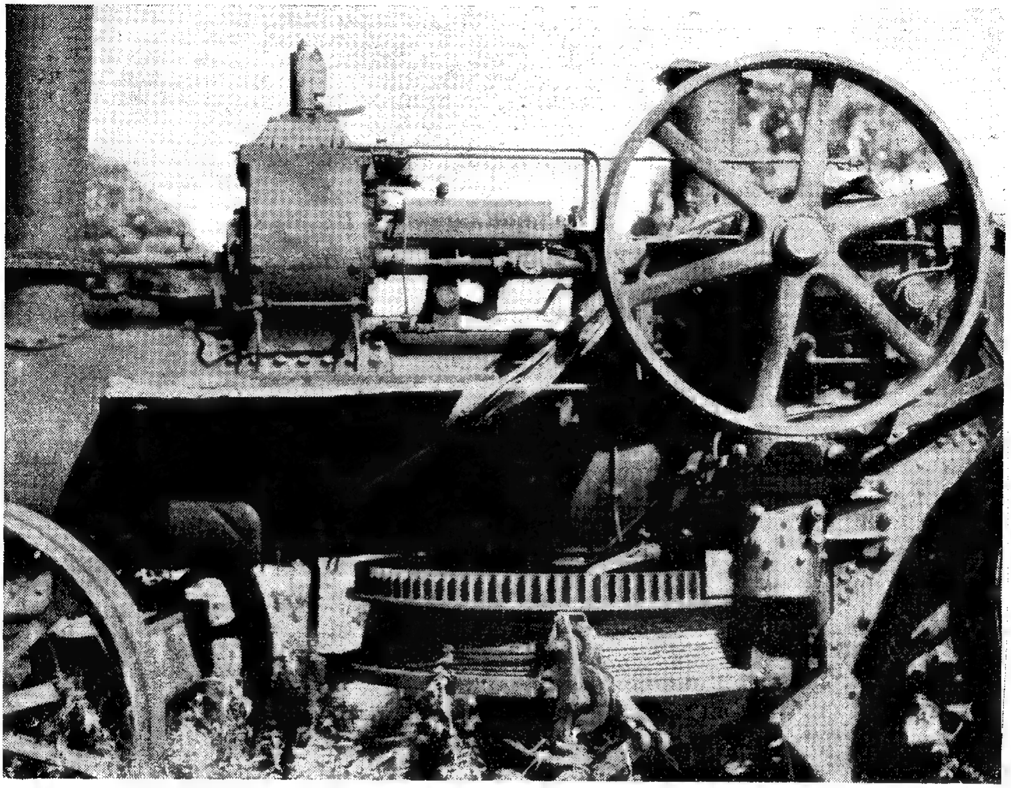


alongside they engines over there. Why!" he exclaimed, warming to his theme, "when they'm 'arnessed to the plough" (and he indicated the Martian death wagon with a jerk of his spatulate thumb) "weeds don't stand a chance. They digs down a coupla feet and 'as it all up and the crops as come arterwards . . ." He held up a hand reverently.

"Then why not use them?" I suggested modestly.

"'Cos us can't get no drivers," he said sadly. "Young 'uns won't have it no-'ow these days. Think them things is beneath 'em, 'cos the works dirty and 'ard. Imagine's they be the lords of creation as soon as they gets their backsides on a tractor. But give I they old engines every time. 'Tis a man's job a-standing up in they cabs and driving some-'at as is worth while. Ah!" he finished, "go on and photograph 'em."

I went over to the engines. They were in perfectly good order and



Silent power

Charlecote Park and there, bow in reverence before the remains of the Twins, who stand year by year for ever silent, because some Man has not come their way to bid them speak.

Petrol Engine Topics

(*Continued from page* 463)

fuels has not yet exceeded that of spark ignition engines and "straight" fuels.

In order to keep the glow-plug at a sufficiently high temperature to ensure ignition, it is essential that ■ certain minimum amount of combustion heat must be available, which means to say that, in practice, the engine must be run practically "flat out" the whole time. This means that the glow-plug is not suitable for engines in which flexibility of control is essential. On the other hand, the glow-plug is immune from many of the troubles inherent to sparking plugs, such as sooting or oiling up, ■ it is capable of burning itself clean, and many engine users find it gives easier starting under the very crude carburation conditions which apply in most small engines.

The position of the glow-plug in the cylinder-head is just as important as that of ■ sparking-plug, but unlike the latter, which prefers a cool position and plenty of turbulence, it is often found desirable to locate the glow-plug in ■ hot pocket, and shielded from too direct contact with cool incoming mixture. It is possible to vary the temperature of the glow-plug at starting, by regulating the voltage of the battery applied, but for obvious reasons, the voltage recommended by the makers should never be exceeded.

While nearly all the engines to which glow-plugs have been applied are two-strokes, it is possible to use them on four-stroke engines, though the conditions for successful operation are more critical than in the former case, and they may be found liable to cooling off, as cylinder head temperatures are usually much lower.

(*To be continued*)

A $1\frac{1}{2}$-Litre HRG Sports-Type Car

by C. W. Field

OBSERVANT model car enthusiasts will notice that this car has the same chassis ■ my old 10 c.c. Auto-Union racing car, which is quite true, as it is a re-build and not a new car !

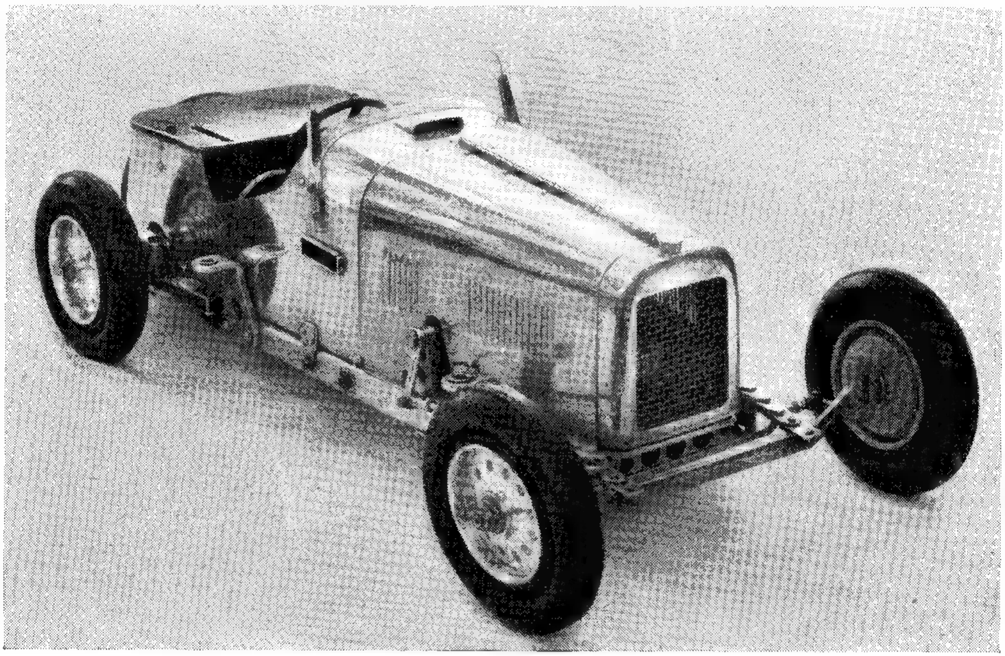
The old body, being very small, made everything most inaccessible, and gave little room for the auxiliaries, so to make things easier, I decided to employ a type of body which gave more room. The wheelbase and track seemed to coincide nicely with the scale of the HRG $1\frac{1}{2}$-litre sports job, and by copying this type, I could house the battery over the rear axle, under the tonneau cover, where it is readily accessible and places weight on the rear wheels, so preventing the wheel-spin which I had previously experienced on slippery tracks.

The engine seen in the photographs, is of course, the one I made from bar stock and the "Ensign" drawings. There are certain apparent differences, but basically it is the "Ensign" design. After two years racing, however, I have since replaced it with ■ "Conqueror" engine made from castings and the exhaust port is now on the near side.

The chassis, made from 20-gauge dural, is the usual type with channel section side and cross members formed on the usual bending bars.

Quarter elliptical springs, made from dural sheet, are fitted all round and this in its natural state is quite springy and very effective The master leaves are 18-gauge, the others 20-gauge.

The "cart" type front axle is made from ■ Rolls Royce "Kestrel" aero engine control lever, and is of oval section. This was bent to the correct shape, spring seats and tubes for the king-pins being silver-soldered in place Stub axles, using $\frac{1}{2}$-in. by $\frac{3}{16}$-in. ball-races for the front wheels, are cut from steel, and the axle and track rod follow Ackerman lines, but are pinned in ■ straight ahead position. A steering arm, drag link and drop arm to the steering box bracket complete the steering layout.



Front view, showing steering layout

The rear axle is made somewhat massive from three chunks of dural ; Z.N. $1\frac{3}{4}/1$ bevels and four $\frac{3}{4}$-in. $\times$ 1-in. ball-races with plain bearings each side of the crown wheel, complete the internals. Since making this axle over two years ago, I have never seen the inside, thanks to the fine Z.N. gears. The axle shaft is silver-steel. The four road wheels, also turned from dural, are drilled to represent Dunlop racing wheels. Rudge Whitworth knock-off hub caps

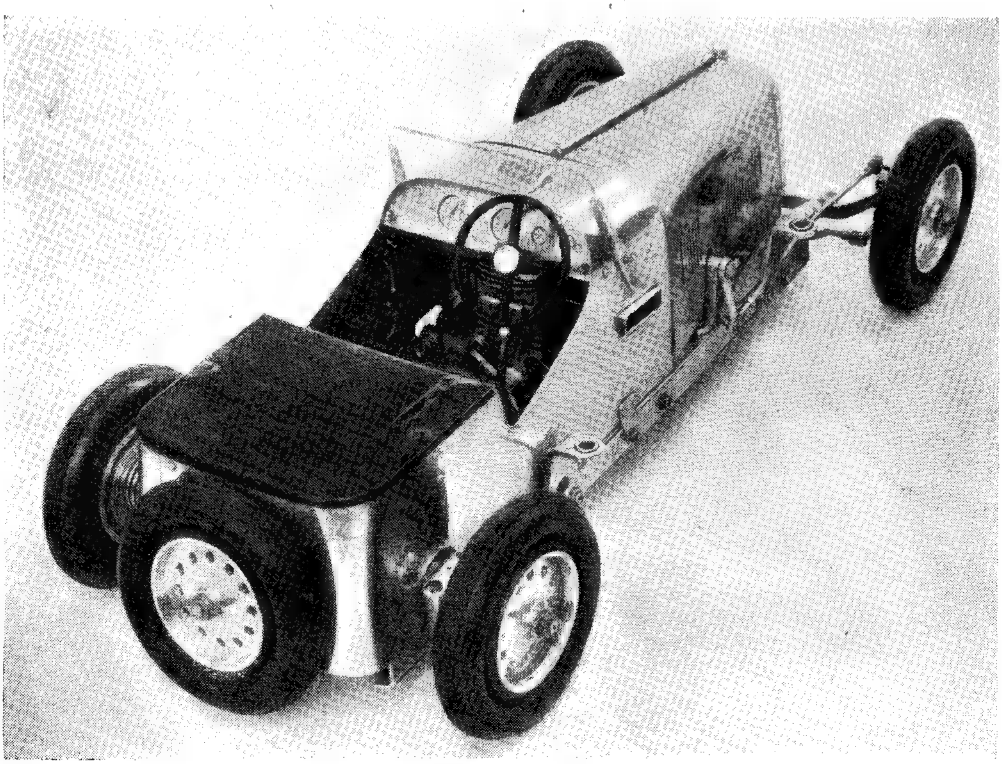
are nuts in my case, cut from 2-B.A Simmonds fixed anchor nuts after being turned and filed [redacted] necessary. "1066" air-cored tyres, $3\frac{1}{2}$ in. on the front and 4 in. on the rear are now used, with suitable retainers, not shown in the photograph, but added since.

The body work is extremely simple and needs no form block. The radiator shaped up from 20-gauge aluminium on [redacted] "Jabroc" former has a stainless-steel mesh, but the bonnet sides were bent over [redacted] broom handle, carefully cut and fitted and riveted with $\frac{1}{16}$-in. snap rivets to a length of piano hinge. Quick-acting fasteners hold it in the closed position.

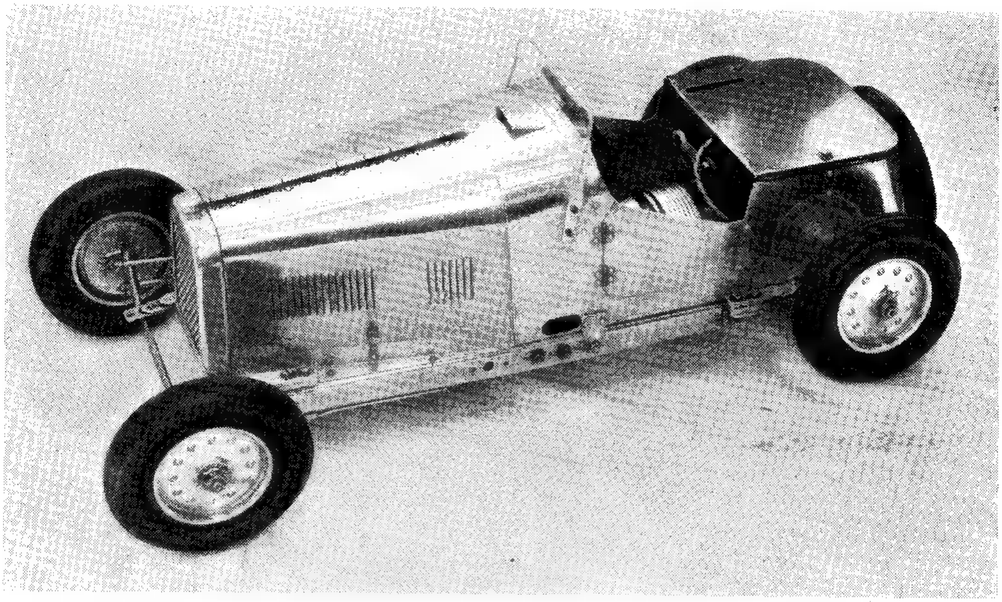
People often ask me how I cut my louvres. Well, here is the "gen." The louvres are cut with [redacted] 0.020 in. slitting saw, running on [redacted] mandrel between centres in the lathe. The top-slide is taken off and an angle-plate bolted on parallel to the C/L of the lathe. A frame of 16-gauge material is made with a square opening cut out, just the size of the area embraced by the louvres. The bonnet side is then sandwiched between the frame and a soft wood block attached to the angle-plate, set up with the C/L of louvres at centre height. The end louvre is cut with the leadscrew clasp nut engaged (l.s. stationary), and the bonnet fed in and the index noted. The leadscrew is now advanced the correct distance for the next louvre and so on. The reason for the frame is because the bonnet sides are 26-gauge alclad and if not securely clamped, as each louvre is cut, swarf gets underneath causing each louvre to get progressively longer, much to one's annoyance, [redacted] it usually means [redacted] lot of work being scrapped.

I attached [redacted] scuttle support to the chassis, knocked over [redacted] former and cut to a deep inverted L-section, which acts [redacted] rear bonnet landing and main body support. The vertical part of the L is to the rear. The body itself, 24-gauge alclad, was now developed with the aid of [redacted] paper pattern and calculation, and in plan view has [redacted] shape like the lower members of the letter H. This was bent over [redacted] suitable bar to suit the scuttle support radius, the bottom edge of which, rests on the chassis, turned in for about $\frac{3}{16}$ in. for stiffness and the rear end of the body sides bent in towards each other at an angle to the vertical (hence the development), and the lap joint riveted with four $\frac{1}{16}$-in. rivets. The door opening, exhaust port and scuttle ventilator openings were then cut out, and four lugs made and riveted for attachment to the chassis by 6-B.A. bolts. The door, which idea I pinched from Mr. Nicholson, for the insertion of the starting cord is cut out and the hinges and handle attached.

The perspex windscreen slides in grooves cut in dural supports which are attached to the body by 10-B.A. bolts, which incidentally hold the bracket for the instrument panel. This



View of the cockpit, showing "Ensign" engine

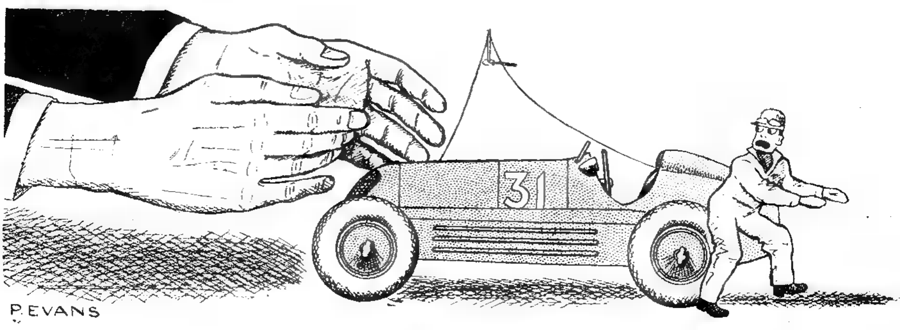


The lines of the $1\frac{1}{2}$-litre HRG sports car are clearly seen in this view. Note scuttle louvre for plug access and battery position

device, besides being ornamental and carrying the ebonite steering wheel, acts as a deflector to the incoming air stream, which it carries down the rear of the cylinder-head before it departs to an easier life, and assists cooling. The spare wheel will probably cause some raising of eyebrows as being superfluous; actually it is a mere shell and weighs practically nothing, but improves what would be a very bare end. Lifting the bonnet, discloses the constant level L-shaped fuel tank, the coil and condenser, and most important, the carburettor.

The drill for starting is to open the door and bonnet, start the engine, adjust ignition (by the gear lever) and the mixture, shut the door and bonnet, and get the car away. Sounds complicated, but it is quite easy. The scuttle ventilator, which clips into place, is to provide access for the spark plug; and the battery and ignition switch are under the tonneau, the switch lever of which sticks up through a slot.

In building this car I thought I would get away from the racing body for a change, though I find the performance is just the same as with the streamlined body. I am, however, expecting the performance with the "Conqueror" engine to be much better.



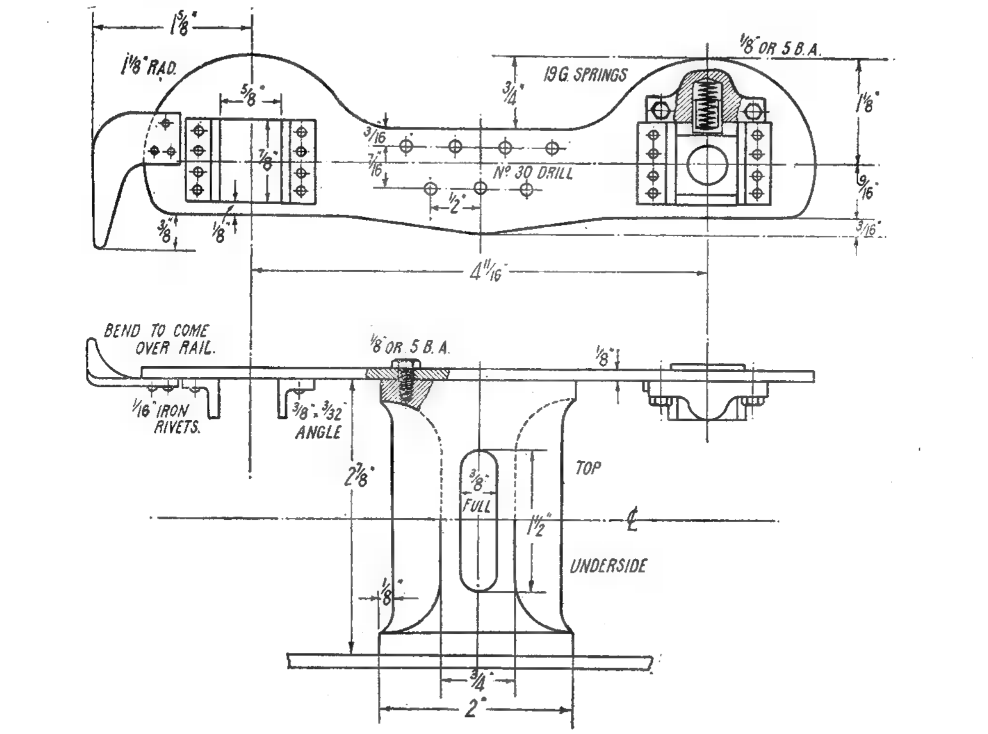
Realism runs riot again!

"PAMELA" by "L.B.S.C."

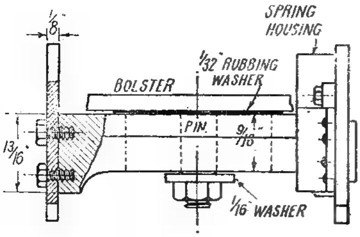
A 3½-in. Gauge Rebuild of a Southern Pacific

As our friends who are building *Pamela* will probably be needing more notes and illustrations by this time, here we go. The leading bogies on the full-sized "spam cans" are not much to write home about, so—as we started from scratch—I have specified a simple type of bogie, which is very similar to those on the "Schools" and the "Nelsons." It has four independently-sprung axleboxes; but instead of the cross-beam with double spring pins, we can use the headless-buffer-pattern springing, the parts being very easy to make and fit. The bogie frames are sawn and filed from 1/8-in. steel plate, all dimensions being given in the drawing. The horncheeks are 7/8-in. lengths of 3/8-in. × 3/32-in. brass angle, riveted at each side of the axlebox openings, by 1/16-in. rivets, which should either be charcoal-iron or brass. Copper rivets work loose when used for frame construction. A guard-iron, cut from 1/16-in. steel plate, is riveted to the front end of each frame, and bent so that when the bogie is erected, the guard-irons will come over the railheads.

It will save time in erection, if the housings for the springs are made and fitted right away. The shape is shown in the drawing, and our approved advertisers will be able to supply castings which will need only a rub on a flat file laid on the bench, to smooth the contact faces; two No. 30 holes drilled for the fixing screws as shown, and the hole for the sliding buffer or plunger, which carries the spring. This can either be drilled 5/16 in. at one fell swoop, or you can drill a 1/8-in. pilot hole, and open it out with a letter O or 8-mm. drill, which is clearing size for 5/16 in. The spring plungers can be made at the same time. A piece of 5/16-in. round steel, bronze or gunmetal rod should slide easily in the hole in the housing; if it doesn't, just take a skim off the outside. Face, centre, and drill down to 5/16 in. depth with 1/4-in. drill; part off at a full 3/8 in. from the end, and then reverse in chuck, chamfer the edge, and very slightly round off the blind end. Don't bother about the springs yet, they can wait until you need them; but attach each housing above the axlebox opening by two 1/8-in. or 5-B.A. screws, letting the housing rest on the horncheeks.



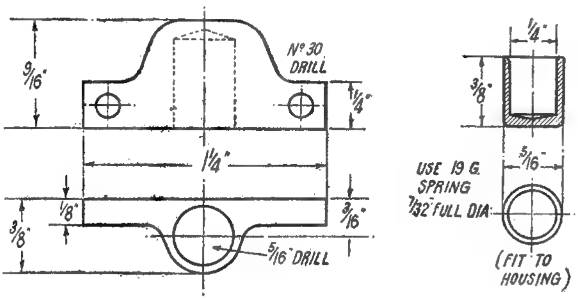
Bogie frames and centre casting



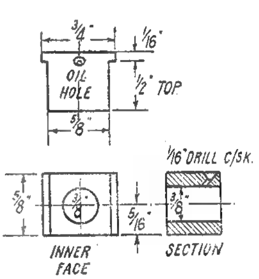
How to erect bogie

Centre Casting

This is my usual " standard " type, except that the sides are deeper than the centre part. Chuck it in the four-jaw and face off the top, or rubbing surface. The ends can either be end-milled, or the casting can be chucked in the four-jaw, and the ends faced off. Anybody who owns, or has the use of a milling machine, can grip the casting in the machine-vice on the table, and a small slabbing cutter on the arbor will true up the ends of the casting in two wags of a dog's tail. The job is practically the same as machining the pump stay. The underside can also be faced off, with the casting in the four-jaw ; the distance from the top rubbing face to the underside, should be a full $\frac{9}{16}$ in. The slot for the pin can be cleaned out with an end-mill, or simply filed, so that a $\frac{3}{8}$-in pin can slide from end to end, without let or hindrance, as they say in the classics.



Spring housing and plunger



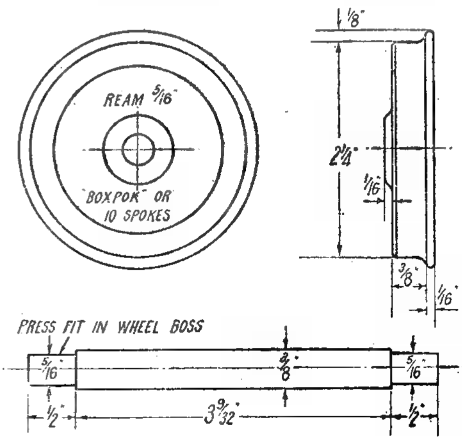
Bogie axlebox

Clamp one frame to the side of the centre casting, horncheeks inside, and set it central, also with top of casting level with the upper edge of the " depression " in the middle of the frame. I made a nobby toolmaker's cramp from $\frac{3}{4}$-in. square rod for jobs like this. Run the No. 30 drill through the screw holes, making countersinks on the casting side ; follow with No. 40 to about $\frac{1}{4}$ in. depth, tap $\frac{1}{8}$ in. or 5 B.A., and secure with screws to match ; hexagon heads for preference. Ditto repeato with the other frame, but make absolutely certain that both sides are dead level. Check vertically by resting the tops on the lathe bed, same as a pair of main frames ; and put a bit of flat bar through the axlebox openings, to check longitudinally, before drilling and tapping the screw holes. No stay rods are needed at front and back, though they can, of course, be put in by anybody who so desires ; but $\frac{1}{8}$-in. frames are stiff enough to " stay put " without assistance, on such a short overhang.

Axleboxes, Wheels and Axles

The axleboxes can be made from cast stick, as supplied by our advertisers, or from bronze or gunmetal bar of $\frac{3}{4}$ in. $\times$ $\frac{9}{16}$ in. section, or nearest available to that size. A piece about 3 in. long will make all four, and the method is exactly as given in full detail for *Tich*. Mill out the rebate each side, either by end-milling, or straight milling ; part or saw-off the four pieces, facing each end in the four-jaw if sawn ; mark off and drill the axle holes in two of the boxes, and use as jigs to drill the other two, keeping each box to its drilled " mate " when erecting. The boxes should not be tight in the horncheeks ; a wee bit easier than the axleboxes of coupled wheels. The axles should also be quite free in the boxes, so that they will not bind when the boxes rise and fall on a rough road, or through crossing frogs or other breaks in the rail surface. Don't forget the oil holes !

The wheels should be either " Boxpok " (B.F.B.) or plain spokes, to match the coupled wheels ; both kinds will be available. They are finished to $2\frac{1}{4}$ in. diameter on tread ; flanges and other dimensions are to my usual " standard,"



Bogie wheels and axle

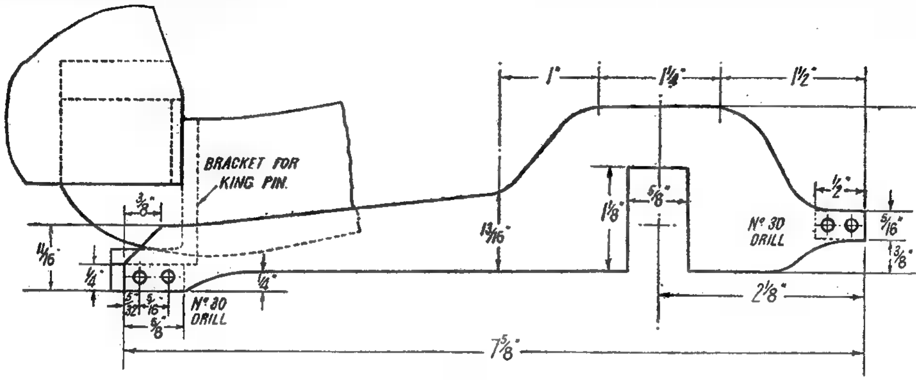
and all are shown in the illustrations. The method of machining, is exactly [redacted] given for *Tich*. The same care should be taken in getting the treads all to the same diameter ; though they are not coupled, and don't assist in driving in any way, they run more freely if they are exactly the same size.

The axles [redacted] turned from ⅜-in. round steel, the hints on turning the coupled axles being followed ; set the rod truly in the chuck, or the axles will bob up and down at every revolution, excessive wear will take place between the sides of the axleboxes, and the horncheeks. Carefully follow out the *Tich* instructions for turning the wheel seats to a press fit ; then press one wheel on each axle.

Wind up a length of spring from 19-gauge tinned steel wire, by the method previously described, using [redacted] bit of ⅛-in. stiff wire, or silver-steel, for a mandrel around which to wind it. The resulting spring should be a sliding fit in the hollow plunger. Cut off a piece for each plunger, and touch the cut end on your emery-wheel, when running fast, to level it off. The length of spring should be just enough to start compressing when the plunger is about $\frac{1}{16}$ in. in, as the front of the engine is pretty heavy ; anyway, adjustments to spring length may easily be made when the engine is finished, by taking out the two screws holding the pocket, when the whole lot comes away. Put the plunger, with spring complete, in the housing, press right home, and put the axlebox in place. As the running position of the axleboxes is in the middle of the openings, put [redacted] little bit of metal ⅛ in. thick, under each box after inserting it. This will keep the boxes in running position whilst the engine is being erected. Then poke the axles through the boxes, and press on the other two wheels. The bogie should then run perfectly free. Check position of guard-irons over rail-heads ; the bogie can then be placed in position over the bogie pin in the bolster on the engine. A brass rubbing washer, cut from 22-gauge sheet, 1¾ in. diameter, with [redacted] ⅜-in. clearing hole in the middle, is placed between the bolster and the bogie ; and [redacted] nut (made from ⅜-in. hexagon rod) plus an ordinary commercial ¼-in. steel washer, will hold it in position, but it must be perfectly free to slide from side to side. No side-control springs [redacted] needed ; the friction between bolster, rubbing-plate, and centre-casting constitutes [redacted] excellent "hunt damper" whilst allowing the bogie perfect freedom to follow the road.

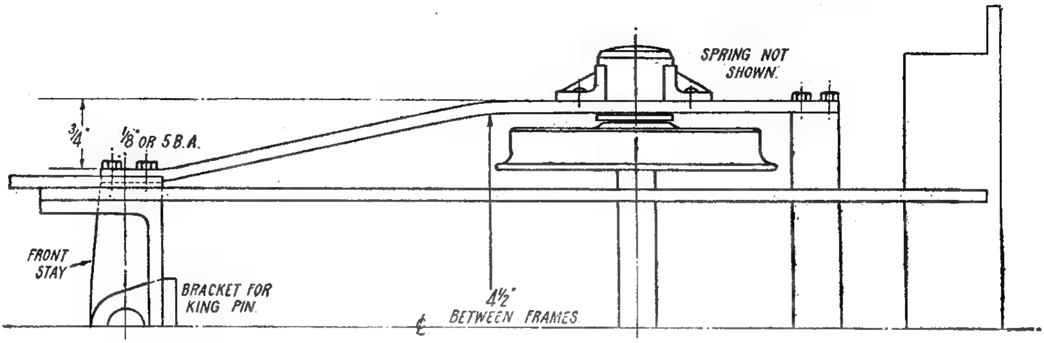
Pony Truck

The pony truck differs from the usual run of such fitments, by having very little "set" in the side frames, and [redacted] very wide front stay, allowing the sides to come right outside the trailing cradle. I might mention here, that the straight-sided cradle directly attached to the inner sides of the main frames, may not allow sufficient side play to the pony wheels, on lines having very sharp curves. I did not want to restrict the width between the cradle frames more than was absolutely necessary, because it meant restricting the width of the ashpan hopper as well. I have at the moment, [redacted] 2-6-2 engine under construction, and have given the trailing wheels $\frac{3}{16}$ in. side play each side of the centre-line, which allows the engine to traverse my south curve of 17 ft. 6 in. radius easily. You will see by the accompanying drawing, that the straight sides of the cradle, directly attached to the inside of the main frames, allow the wheels precisely the same amount. If the engine is required to traverse [redacted] sharper curve than that mentioned above, set the cradle frames closer together, by putting a distance-piece between them and the main frames, and using [redacted] narrower piece of channel steel as [redacted] spacer or stay. For [redacted] example, I have shown in the alternative illustration, $\frac{3}{16}$ in. distance pieces, closing in the cradle to a width of 2¼ in., and allowing the pony wheels ⅜ in. movement each side of centre. The slots in the drag beam would naturally have to be cut to suit ; but there would be no need to close in the leading end of the pony truck, unless the builder wishes. The cradle could also be closed in by bending each frame [redacted] little toward the centre line of the engine, and slotting the drag beam to suit. Two pieces of ⅛-in. steel plate 7 ⅞ in. long and 2 in. wide, will be needed for the pony frames ; these [redacted] cut out, as shown in the illustration, and set over as indicated in the plan, the bends being made at ⅝ in. from the narrow end, and at 3¾ in. from the wider end.



Pony truck frames

The amount of offset is $\frac{3}{4}$ in.; the frames are $4\frac{1}{2}$ in. apart at the back, and 3 in. at the front. Beginners note that the easiest way to get both sides bent to the same angle, is to bend one, and use it as a guide to bend the other. Incidentally you would be surprised at the number of beginners as shown in the plan view; but if preferred, one small screw can be put into each joint, and the whole lot brazed up solid. This makes an exceedingly strong job, and is quite O.K. as the frames never need to part company with the stays again, during the lifetime of the engine.



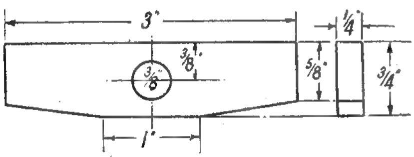
Plan of pony truck erected

who have written in and thanked me for putting in these little remarks especially for their benefit. They say that if they had to study a text-book and ferret it all out for themselves, the job would never even be started, let alone reach a successful conclusion. Well, that is just what your humble servant is here for! Beginners and other inexperienced workers are very much akin to travellers in a strange country. If the roads are well sign-posted, they haven't the least difficulty in finding their way around; without them, they would need a map and a compass, and might easily go astray. I do my best to put up plenty of sign-posts!

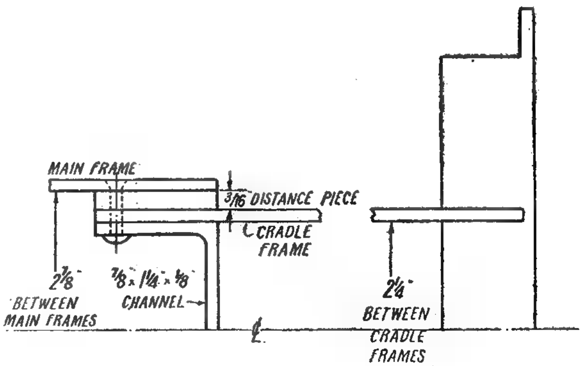
The rear stay is just a plain piece of steel bar $\frac{1}{2}$ in. wide and $\frac{5}{16}$ in. thick, squared off in the

However, take the same strict caution as before, to have the frames "spot on" regarding exactness in alignment.

If all goes well, I will give details of axleboxes, springs, wheels and axles, and describe the erection in the next instalment of this serial; there are one or two interesting points. The king-pin will be supported by an L-shaped bracket bolted to the cross-stay at the end of the main frames; and the weight at the rear end will be taken by a pair of rollers, same as on my "super-Southern" *Tugboat Annie*. Since the repairs to the line were done, this lady whizzes around my curves at *Lady Vera* speed, and the roller arrangement at the back end answers perfectly, allowing perfect freedom, and preventing any chance of



Above—Front stay for pony truck



Right—Alternative arrangement for sharp curves

chuck to a length of $4\frac{1}{2}$ in. The front stay is a 3-in. length of 3-in. × $\frac{1}{4}$-in. steel, bevelled off as shown, so that each end is $\frac{5}{8}$ in. long. This one has a $\frac{3}{8}$-in. hole in the middle, for the king-pin. The frames are attached to the stays by two $\frac{1}{8}$-in. or 5-B.A. screws—hexagon head for preference—put through the clearing holes in the frames, into tapped holes in the two stays,

derailment. Meanwhile, if anybody has caught up to the notes, and is stuck for a job, he can go ahead and fit brake blocks, hangers and pins to the coupled wheels, exactly as described for *Doris*—though personally, I'd rather make certain a locomotive could *run* all right, before thinking about supplying ways and means of *stopping* it!!

Novices' Corner

Mounting Work on the Lathe Cross-slide

THE cross-slides fitted to lathes vary greatly both in size and general construction. The older types of lathes, and particularly those designed for amateur use, were furnished with [redacted] cross-slide of large size ; and, as this enabled quite large castings to be bolted in place for machining, it was known [redacted] boring table. On the other hand, some lathes, the precision type of lathe for example, have a small cross-slide which serves merely to carry the top slide ; in this case, the boring table, which can be substituted for the cross-slide, is supplied as an extra fitting and must be ordered at the same time as the lathe so that it can be accurately fitted by the manufacturers. To enable work to be readily bolted to its surface, the cross-slide or boring table is furnished with a series of T-slots. These slots are, however, sometimes [redacted] source of trouble, for in [redacted] lathe of, say, $3\frac{1}{2}$ in. centre height, the manufacturer has to face the problem of fitting [redacted] saddle, a cross-slide, a top slide, and a toolpost into this somewhat restricted space. As a consequence, the depth of the T-slots may be made rather less than the standard adopted for the machine tools of robust construction used in industry.

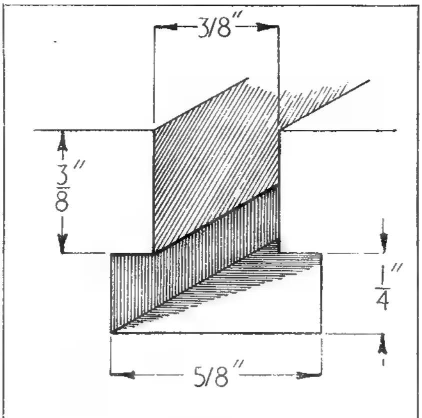


Fig. 1. Showing the dimensions of a standard T-slot

Fig. [redacted] shows the proportions of a standard T-slot suitable for use with a T-bolt of $\frac{3}{8}$ in. diameter. In this example the bolt head is well supported, and the mass of the surrounding metal is ample to withstand severe bolting strains ; but, where the construction is less robust, care must be exercised when bolting work to the saddle.

Where, as shown in Fig. 2A, a component such as the top slide is bolted to the cross-slide, it will be clear that the wings or lips of the T-slot are compressed between the bolt-head and the base of the slide, so that forcible tightening of the clamp-nut does not tend to distort or damage the parts. The T-slots are, however, also employed for securing irregular work to the saddle, and, as illustrated in Fig. 2B, where the surface of the boring table is not directly supported by the component, the lips at the mouth of the T-slot may easily be bent upwards or more likely, broken off if the clamping pressure is excessive. It is not uncommon to find the T-slots in the slides of small lathes broken in this way, as a result of carelessness or misuse. Whenever possible, therefore, aim at bolting work to the cross-slide in the manner indicated in Fig. 2A.

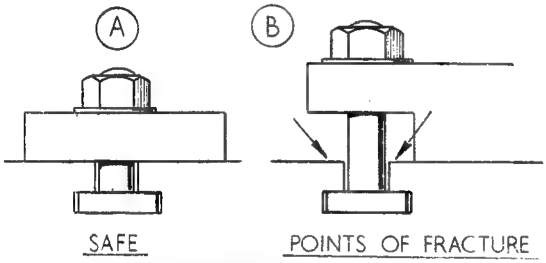


Fig. 2. Methods of clamping work with a T-bolt

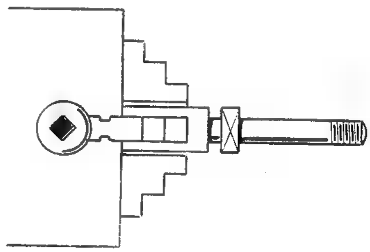


Fig. 3. Turning a T-bolt from square material

Making T-bolts

It often happens that one or more T-bolts are required of greater length than those in general use ; if so, there is no great difficulty in making any that may be needed. For ordinary use, it is advisable to machine the bolts from the solid, and if square-section steel of the correct size is available, the head will only need to be machined to length after the shank has been turned to size and threaded. The bar is gripped in the four-jaw chuck, as shown in Fig. 3, and set to run truly with the aid of the test indicator applied in turn to the four flat sides of the material. The bolt shank is turned to size with [redacted] knife-tool and the thread is formed with a die mounted in the tail-

stock die-holder; parting-off the head to the correct length then completes the machining of the bolt. Should round bar be used for making the bolt, the head is turned considerably oversize so that, when the two flats are filed to allow the head to fit in the T-slot, the head itself will be left with an ample bearing surface.

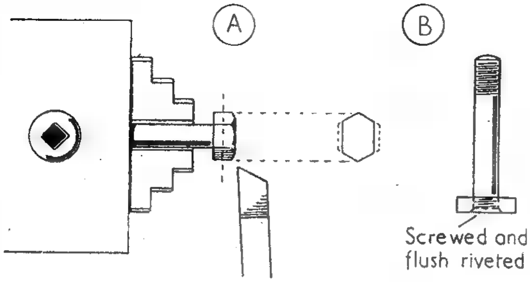


Fig. 4. (A) Making a T-bolt from hexagon-headed bolt; (B) Using round material to make a T-bolt

To save time and materials, T-bolts are often machined from ordinary hexagon-headed bolts, as illustrated in Fig. 4A. The head must be faced to the correct thickness, and two of its sides are filed down so that the bolt can enter the slot in the slide. For light duty, it will serve quite well if the T-bolt is built up by attaching a head to a piece of round rod. The head, in this case, must be firmly screwed in place and the shank is then riveted over into a light countersink, as shown in Fig. 4B. To finish the head, the shank is gripped in the self-centring chuck and both the upper and lower surfaces of the head are faced true and flat to give an even bearing in the T-slot.

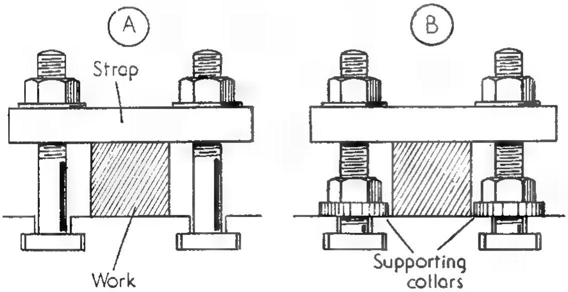


Fig. 6. Using a strap to clamp work to the saddle

An ordinary bolt or screw can also be used for light holding in the manner illustrated in Fig. 5A. Here, a nut-piece is made to fit the T-slot and the bolt is screwed in from above when clamping the work, but at the same time care must be taken to ensure that the bolt when tightened does not bottom against the floor of the T-slot; this is done by fitting washers of the appropriate thickness under the bolt-head.

When this method of clamping work is used, the bolt will have a more secure grip if the nut-piece is made of the form shown in Fig. 5B.

Clamping the Work in Place

A method commonly used for securing a component, such as a casting, to the cross-slide is to apply the clamping pressure by means of a strap or bridge-piece held down by two T-bolts, as illustrated in Fig. 6A. Care must be taken, however, to apply the strap so that it rests evenly

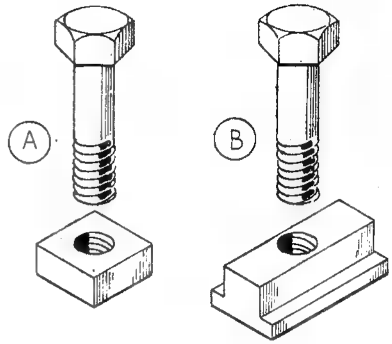


Fig. 5. A clamping-bolt screwed into a T-slot nut

on the work when the clamp-bolts are tightened, and, in addition, in using the spanner, allowance must be made for any lack of strength in the T-slots. Some additional support will be given to the lips of the T-slot if, as shown in Fig. 6B, nuts are employed to bolt collars against the mouth of the T-slot; but to be effective, these nuts must be tightened more firmly than those clamping the strap.

Fig. 7 depicts a widely used method of clamping work to the cross-slide; but, here again, the T-slot is highly stressed and it is advisable to employ, whenever possible, more than one clamp in order to distribute the bolting pressure. The

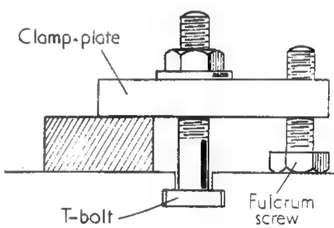


Fig. 7. A T-bolt used with a work clamp

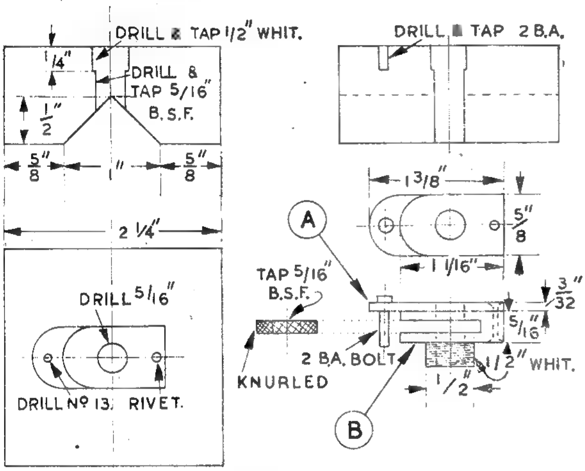
fulcrum screw is first adjusted to level the clamp-plate, or to raise it slightly at the end to which the screw is fitted, and the work is then secured by tightening the central clamp-nut. Angle-plates, when bolted to the cross-slide, are much-used for mounting work that has to be machined from the lathe mandrel, and, as the T-slots will then be well supported against solid metal, the holding-down bolts can be firmly tightened without risk of doing damage. To obtain a better grip and to allow for any slight irregu-

(*Continued on page* 482)

A SIMPLE SCRIBING BLOCK

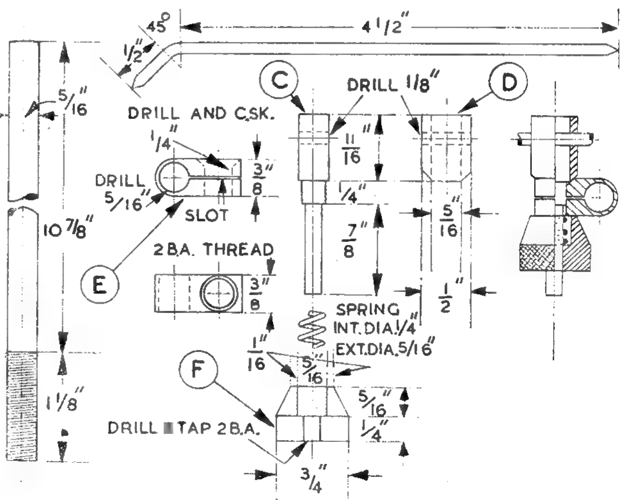
FINDING myself minus [redacted] decent scribing block recently, and with a little time to spare, I determined to set about making one, and write these notes in the hope that perhaps a few more home-made blocks will now make their appearance.

The drawings are very nearly self-explanatory. The block itself is $2\frac{1}{4}$-in. × $2\frac{1}{4}$-in. × 1-in. mild-steel bar. The "V" is cut out by using a hacksaw and then filed and scraped. The base



is scraped dead flat and all other surfaces scraped true. A $\frac{1}{4}$-in. hole, drilled dead in the centre of the upper surface of the block, is then counterbored, using [redacted] 25/64-in. drill to a depth of $\frac{1}{4}$ in. The $\frac{1}{4}$-in. hole is tapped, using a $\frac{5}{16}$-in. B.S.F. tap, care being taken on the few final threads where the tap was cutting on the sides of the "V." The larger hole is tapped $\frac{1}{2}$-in. Whitworth to a depth of $\frac{3}{16}$ in. The stock consists of a 12 in. length of $\frac{5}{16}$-in. mild-steel rod and is threaded $\frac{5}{16}$-in. B.S.F. for $1\frac{1}{8}$ in. from the base. Part (A) consists of [redacted] piece of $1\frac{3}{8}$-in. × $\frac{5}{8}$-in. × 3/32-in. mild-steel plate, radiused at one end and drilled No. 13 and $\frac{5}{16}$ in. [redacted] shown. Part (B) consists of [redacted] piece of $\frac{11}{16}$-in. × $\frac{9}{16}$-in. × $\frac{5}{8}$-in. mild-steel, radiused at one end. This is now placed between centres and [redacted] $\frac{1}{2}$-in. lug, $\frac{1}{4}$ in. long, is made on one side. This lug is then threaded $\frac{1}{2}$-in. Whitworth and [redacted] $\frac{13}{16}$-in. × $\frac{1}{8}$-in. slot is cut as shown. Parts (A) and (B) are now riveted as shown, and the $\frac{5}{16}$-in. hole is drilled through both, using part (A) as a drilling jig. A $\frac{5}{16}$-in. B.S.F. nut, or better still, a $\frac{5}{16}$-in. B.S.F. tapped washer, $\frac{1}{8}$ in. thick and knurled on the outside diameter, is now placed in the slot. Parts (A) and (B) should [redacted] be assembled with the base and, using part (A) [redacted] jig, the base is drilled No. 26 for [redacted] depth of $\frac{1}{4}$ in. and tapped 2-B.A. A 2-B.A. bolt, $\frac{1}{2}$ in. long, is now screwed through (A) into the base, thus locking parts (A) and (B) to the base. The stock can [redacted] be screwed through the washer into the base, the washer being used for locking. The section can now be put on one side and work on the scriber can be commenced.

The scriber itself consists of [redacted] piece of $\frac{1}{8}$-in. rod, 5 in. long, hardened and sharpened at both ends, one end being bent [redacted] shown. A piece of $\frac{5}{16}$-in. rod, $1\frac{7}{8}$ in. long, is now chucked and turned as shown (part C). A collar (part D), $\frac{5}{16}$ in. internal diameter, $\frac{1}{2}$ in. outside diameter and $\frac{11}{16}$ in. long, has one end shaped [redacted] shown and fitted over part (C). Both parts are now drilled $\frac{1}{8}$ in. Part (E) consists of [redacted] piece of $\frac{7}{8}$-in. × $\frac{3}{8}$-in. × $\frac{3}{8}$-in. steel radiused as shown, one end being drilled $\frac{5}{16}$ in. on the top, and the other end $\frac{1}{4}$ in. on the side. The $\frac{1}{4}$-in. hole is countersunk to fit snugly over the collar (D). A 1/32-in. slot is cut in part (E) lengthwise. The scriber itself is pushed through the $\frac{3}{16}$-in. hole in the collar (D) and the part (C), and part (E) is then placed with the $\frac{1}{4}$-in. hole over the $\frac{1}{4}$ in. section of part (C), the collar (D) fitting into the countersink. A spring washer is now placed over the 2-B.A. threaded



portion of part (C) and finally a knurled nut, counterbored $\frac{5}{16}$ in. for $\frac{5}{16}$ in. of its length and drilled No. 26 and tapped 2-B.A. for the remainder, is screwed on. The scriber portion can now be placed over the stock which fits through the $\frac{5}{16}$-in. hole in part (E), and the whole scriber can be tightened up by using nut (F).

—D. BLACKHURST.

IN THE WORKSHOP

by "Duplex"

60—*Building the $\frac{3}{8}$-in. Cowell Drilling Machine from Castings

NOW that the machining of the headstock has been completed, it remains to describe the fitting of the driving gear consisting of the drill spindle, with its belt pulley, and the jockey pulley assembly. In addition, some further modifications that were introduced will be dealt with as the work proceeds.

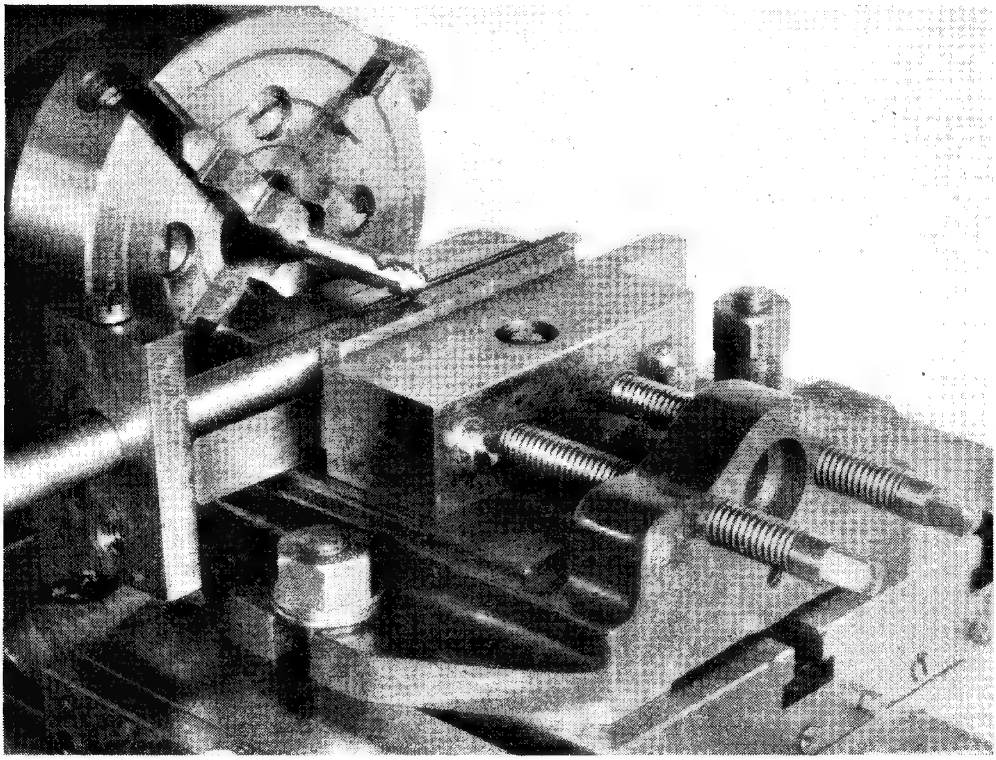


Fig. 1. Flycutting the keyway in the drill spindle

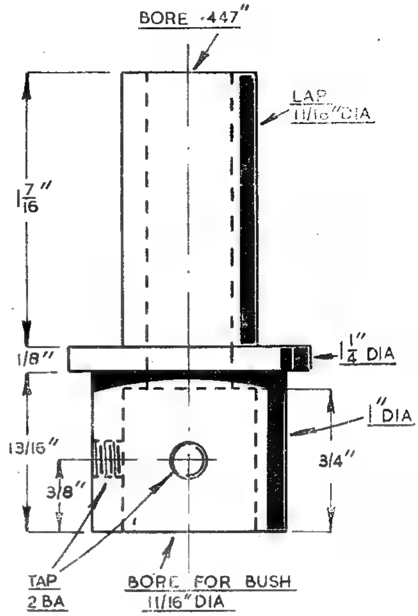
The Spindle

The material supplied for making the drill spindle consists of a length of medium carbon-steel of 40 ton tensile strength, and, although this steel is tough and has good wearing qualities, it can nevertheless be machined quite readily at ordinary turning speeds.

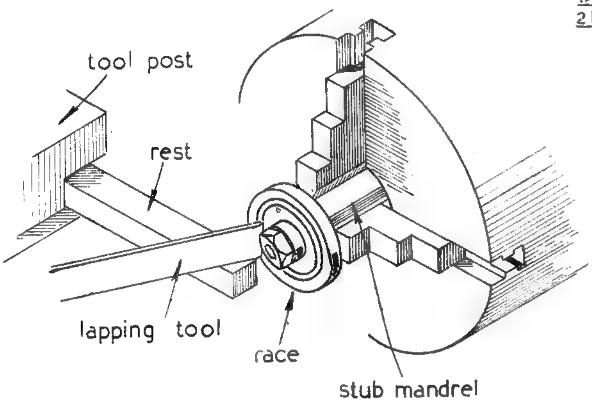
The rod must first be centre drilled at both ends, and, to do this, it is gripped in the chuck while the outlying end is supported in the fixed steady. After one end has been faced and centre drilled in this way, the work is reversed and the other end is treated similarly. A lathe carrier is now secured to that end of the rod on which the taper to carry the drill chuck will later be formed, and the work is then mounted between the lathe centres. As the finishing cuts will be taken at moderately high speed, it is advisable to attach a counter-weight to the driver plate, so as to balance both the driving dog and the carrier itself.

When machining a long, slender spindle, it should be borne in mind that the removal of metal may liberate internal strains in the material and distortion of the work may result ; to avoid this, the spindle should as far as possible be left slightly over-size in all parts, so that the final light finishing cuts will correct any errors of this nature. A further difficulty is that the tool will, in the later stages, tend to spring the shaft,

*Continued from page 397, "M.E.," March 23, 1950.

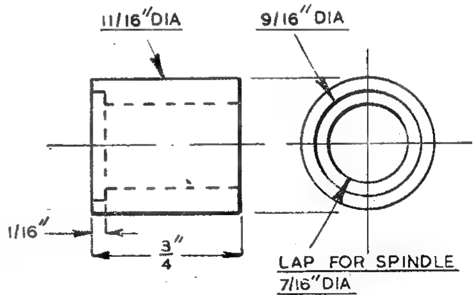


Above—Fig. 3. The bush carrier fitted to the headstock



Left—Fig. 2. Arrangement for lapping the ball thrust-races

Below—Fig. 4. The spindle bush fitted to the carrier shown in Fig. 3



and it is essential, therefore, that the area of contact between the tool and the work should be kept small.

A right-hand knife tool with only a very small flattening or rounding of its extreme tip will serve well, but the actual cutting edge must be kept really sharp throughout the turning operation. At first, the shaft will be sufficiently rigid to withstand machining without the support of a steady, but, as the diameter becomes reduced a travelling steady should be mounted to follow in the wake of the tool. Great care must be taken, when adjusting the steady after each cut, to ensure that the shaft is not deflected by the pressure of the contact pads. A fine feed with the automatic traverse of, say, 250 to 300 turns per in. is set up, and only fine cuts should be taken towards the end of the turning operation in order to prevent heating of the work and to reduce the tool pressure. It is advisable to reset the tailstock centre for each new cut, for wear will upset the adjustment, and expansion of the work, due to heating, may, if checked, cause bowing of the shaft. A continuous supply of cutting oil should be fed to the work ; a drip-can will serve this purpose, but it is apt either to give an intermittent supply or to flood the work unnecessarily. A brush, held in contact with the work by means of a clip attached to the tool-post, has been found to supply all the lubrication required when taking long cuts, and at the end of each cut the brush is removed and again dipped in the cutting oil.

As a screwcutting tool exerts considerable radial pressure, the screw thread to carry the spindle collars should be cut before the shaft is weakened by being reduced to its finished diameter.

Two grooves, to mark the start and finish of the thread, should be cut to the thread core diameter by using a narrow parting tool while the shaft is supported by the travelling steady.

As the length of the thread to be cut is so short, it will probably be found more convenient to rotate the work with the mandrel handle rather than to employ the ordinary lathe drive.

The portion to be threaded was turned to 2-thousandths of an inch under the nominal diameter, and the thread was cut to a depth 1-thousandth less than the theoretical dimension ; it was then found that a die could be run on with the fingers to finish the thread to size. It should here be mentioned that the spindle collars were threaded with a tap supported by the tailstock centre, and, in this way, the threads on the shaft and in the collars were made to mate accurately.

Both the $\frac{1}{2}$ in. diameter and the $\frac{7}{16}$ in. diameter portions of the spindle are turned to approximately $\frac{3}{4}$-thousandth of an inch over the finished diameter to allow for lapping to size later.

The next step is to mount the shaft in the reversed position for machining the tapered nose to carry the drill chuck.

The dimensions of the taper formed in the chuck body are usually stated by the manufacturers, and if the lathe is equipped with a taper-turning attachment there should be no great difficulty in reproducing the equivalent taper on the spindle nose.

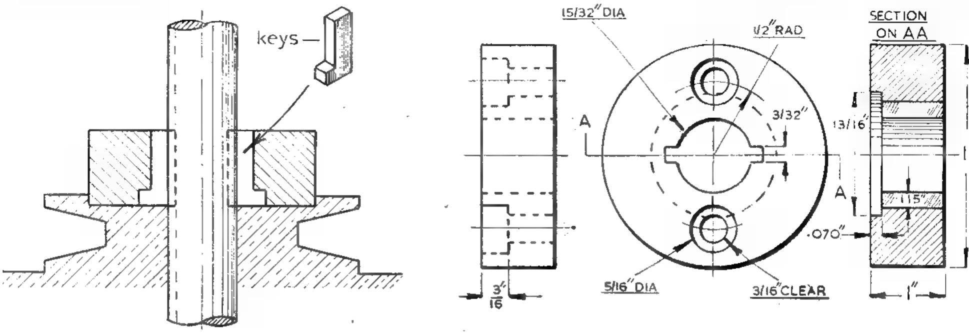


Fig. 5. The driving collar fitted to the modified form of drive pulley

Short tapers are, however, more commonly turned by setting over the top-slide, and, when this method is adopted, the slide is either set from its graduated base, or a protractor can be used to set the V of the slide with reference to the lathe faceplate.

To enable small corrections to be made to the slide setting, the test indicator, resting on the lathe bed, is brought into contact with the tail-portion of the top-slide and re-adjustment can then be made to within a thousandth of an inch.

As, when machining the taper, there is but little room for making corrections owing to the small amount of surplus metal remaining once the chuck has begun to engage, it is advisable for inexperienced workers to begin by cutting a trial taper on another piece of material. The fit of the taper is easily tested by drawing a series of longitudinal lines on the male taper and then engaging the chuck with a slight twisting motion; obliteration of the pencil lines will then show where contact has been established. In the present instance, the taper was machined in the following manner. A standard chuck arbor was fitted to the Morse taper bore in the lathe mandrel; the test indicator mounted in the lathe tool-post, was fitted with a flat-surfaced contact-piece, and the latter was brought into contact with the taper of the chuck arbor at exactly centre height; the top-slide was then adjusted until traversing the slide caused no variation in the reading of the test indicator.

Next, with a fine-pointed tool, again set at exactly centre height, the taper was machined with the lathe running at high speed. A final pencil line test showed that an extremely accurate result had been obtained. The bearing surfaces of the spindle can now be finished by lapping: one portion to fit the quill bushes which are already in place, and the other to the $\frac{7}{16}$ in. dimension specified.

The next operation is to cut the keyway in the spindle to accommodate the driving key fitted to the pulley. For this purpose, either a circular milling-cutter or a fly-cutter can be employed; the latter has the advantage that it can readily be ground to size, so that the machining operations will allow the key to slide in the spindle and at the same time be a firm fit in the pulley keyway. The arrangement adopted is shown in Fig. 1, where it will be seen that the spindle is firmly

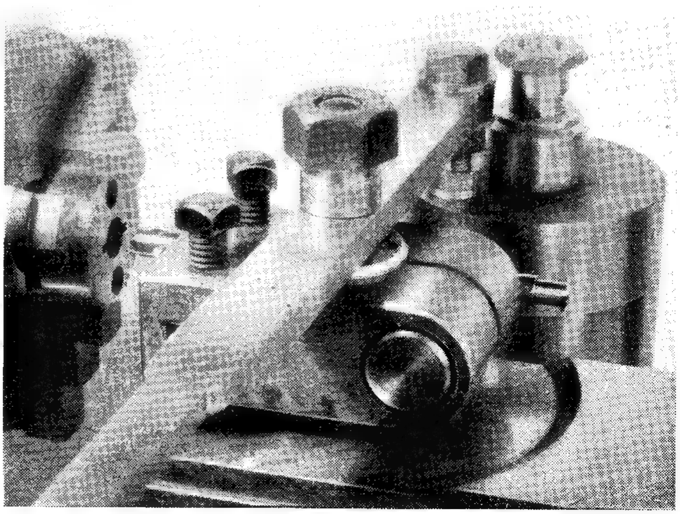


Fig. 6. Method of cutting keyways by a shaping operation in the lathe

supported in a machine vice attached to the lathe cross-slide. The spindle rests on a packing strip which sets the work to the correct height for machining the keyway to its full depth at a single passage of the cutter. The easiest way, perhaps, of setting the tool to cut to the correct depth, is to mount the cutter bar in the four-jaw chuck, and to adjust the latter so that the cutter, when rotated by hand, just touches the upper surface of the work. The test indicator, mounted on the spindle of the surface gauge with its base resting on the lathe bed, is then brought into contact with the cutter and the dial is turned to the zero mark. Next, the four-jaw chuck is adjusted, by reference to the test indicator, to set the cutting edge of the tool outwards from the centre for a distance equal to the depth of the keyway.

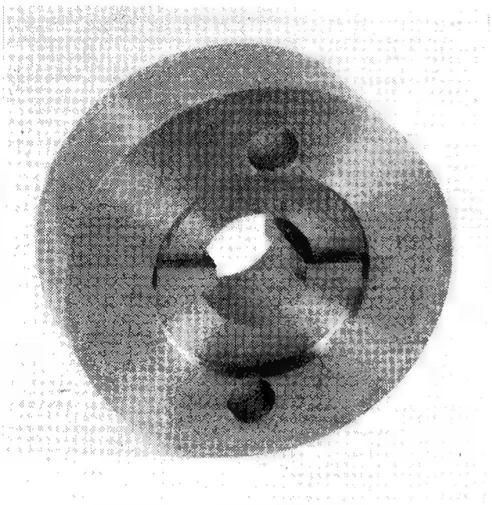


Fig. 7. View of the underside of the driving collar, showing the keys in place

It will also be seen in the photograph, Fig. 1, that a flat metal strip is clamped alongside the spindle to act as a setting face when centring the cutter on the work; this procedure was described in connection with cutting the keyway in the pinion feed-shaft. It will be noticed that, in the arrangement shown, the work is fed forwards in the same direction as the run of the cutter; this gives a very good finish to the work, but care must be taken to adjust the cross-slide locking-screws to make the feed rather stiff in operation, otherwise the tool may grab and jam in the work. A very slow feed should be used and the saddle must be locked while the keyway is being cut. Any burrs set up on the shaft are removed with an oilstone slip, and the work on the spindle is then complete.

The Drive Pulley

The methods employed for machining V-pulleys were described in a recent article, but the present pulley has its bore formed with a step to accommodate the driving key, as shown in the blue print. To ensure that the V-grooves are turned concentric with the bore, the pulley is, therefore, mounted on a stub mandrel, fitted with a nut at its outer end to clamp the pulley securely against a shoulder formed on the mandrel itself. The keyway can be cut by a shaping or slotting operation in the lathe while the pulley is gripped in the four-jaw chuck and accurately centred. The arrangement is similar to that shown in the photograph Fig. 6. The same cutter-bar and fly-cutter as were employed for machining the spindle keyway are again used, but the inset cutter is slightly reduced in width by sharpening the front cutting edge, and the tool is set sideways in the bar so that it cuts when drawn through the work. When the shaping rig shown is set up, the keep-plate and feed screw of the top-slide are removed, and a hand lever, secured to the tool post is anchored to a block attached to the cross-slide. The cutter must be set at exactly centre height and the lathe mandrel is locked.

The keyway is cut by moving the top-slide to and fro while the tool is fed outwards, by means of the cross-slide feed, until the required depth is obtained.

The Spindle Thrust Bearing

The lower thrust-race may be made a push fit on the spindle, but the upper will be the better for having some radial play so that the ball tracks can line up correctly. Although the races supplied appeared to be well-made, the ball tracks showed tool marks which it was decided to remove by a lapping process akin to that used in the production of commercial ball-bearings. A stub mandrel was, therefore, turned and fitted with a nut to secure the individual races in place, and a bar gripped in the lathe toolpost acted as a lapping rest, as illustrated in Fig. 2. A lap with a rounded tip was made from a length of aluminium strip, and this, after being charged with a mixture of coarse carborundum powder and oil, was pressed against the ball track with the lathe running at high speed.

To avoid forming rings on the work, the lap should be kept moving over the ball track, and from time to time the tool will need to be re-charged with lapping compound. This process was continued until all tool marks had been removed, and the ball track was finally given a mirror finish with a lap consisting of a strip of hard wood charged with flour emery. When the thrust-bearing was re-assembled on the spindle, it ran almost silently, whereas before being lapped it was rather noisy.

The Headstock Spindle Bush

The machining and fitting of this part is a straightforward piece of work when it is made to the dimensions given in the blue prints. However, owing to purely personal preferences, it was decided to modify the construction somewhat, and this part was made in the form shown in the drawings, Figs. 3 and 4. The steel bush-carrier, Fig. 3, is made a light press fit in the headstock casting where it is secured in place by means of two 2-B.A. Allen grub-screws spaced at 90 deg.; the upper portion is finally lapped to form a bearing for the modified type of drive pulley which will be described later.

The part is bored to afford a clearance of 10-thousandths of an inch for the spindle, and at its lower end the bore is enlarged to carry the cast-iron bush shown in Fig. 4; this bush is also secured in place with two Allen grub-screws. This change of design was made for the following reasons. It was decided to give the bushing a longer bearing in the headstock casting and also to increase the length of the pulley bearing. Any distortion resulting from the case-hardening process may be difficult to correct with ordinary equipment; commercially, of course, sufficient surplus material would be left to enable the part to be ground to size, both internally and externally, after hardening. As the parts were not hardened, ■ cast-iron bush was fitted and lapped internally to form the spindle bearing. Cast-iron was chosen, rather than bronze, owing to its good wearing qualities and its capacity, even with scanty lubrication, to run without causing scoring of the spindle. In coming to this decision, note was taken of the condition of the bearings in a drilling machine, of somewhat similar design, built from castings more than thirty years ago. In this machine the cast-iron upper spindle bearing in the headstock carries the driving load through a pair of bevel pinions, and the lower portion of the drill spindle is carried directly in the cast-iron quill. In spite of driving this machine at times beyond its capacity and giving rather irregular oiling, there is still no detectable shake or other signs of wear in any of these bearings after all these years of use. It will be noted that the bush shown in Fig. 4 is recessed at its lower end; this is to allow for any projection of the threaded portion of the spindle carrying the upper thrust collars. The length of the bush must be adjusted so that it keeps clear of these collars when the spindle rises to its full height.

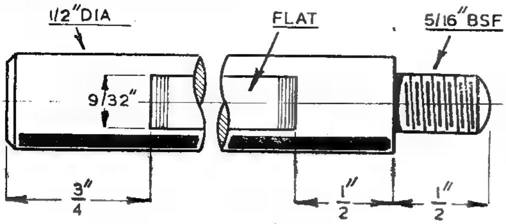


Fig. 8. Showing the flat machined on the jockey pulley arm

Modified Spindle Driving Arrangement

The pulley is bored $\frac{11}{16}$ in. for the whole of its length; this enables the bore to be lapped to ■ accurate running fit on the upper part of the bush-carrier illustrated in Fig. 3, but when this form of construction is adopted a separate driving collar must be fitted to the top of the pulley. The drawings, Fig. 5, show the design of this collar, which is located in a recess turned in the upper surface of the pulley accurately concentric with the pulley bore.

Two ■ B.A. Allen screws with capped heads are used to secure the drive collar in place. As the actual drive to the spindle is now some distance above the spindle bearing, it is advisable to distribute the driving pressure evenly on the spindle by cutting two keyways in the shaft and fitting two corresponding keys to the drive collar. The two keyways must be accurately spaced at 180 deg. in both the spindle and the driving collar to ensure that the driving load is equally shared, and that the keys work smoothly even when closely fitted.

The spindle is machined as depicted in Fig. 1, and the indexing of the two keyways is carried out with the aid of ■ rectangular setting-piece, secured to the spindle with ■ brass set-screw; this attachment can be seen at the left of the photograph. The two opposite sides of the setting block must be exactly parallel, and when cutting the first keyway one side is aligned with ■ square resting on the cross-slide. To index the second keyway, the spindle is rotated and the opposite side of the block is then set at right-angles to the surface of the cross-slide. Both keyways are cut to a depth of exactly 0.055 in. by employing the method of setting the cutter already described.

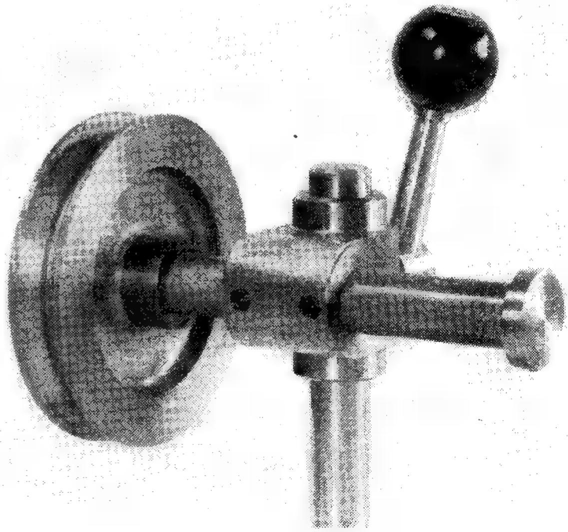


Fig. 9. The jockey pulley assembly

The two corresponding keyways are cut in the drive collar while the part is still mounted in the chuck after forming the central bore. As shown in Fig. 6, the boring bar, fitted with its inset cutter, is again used for the shaping operation carried out in the lathe. The work, in this instance, was indexed to 180 deg. by engaging ■

detent with the large back-gear wheel that is keyed to the mandrel. The keyways are cut to an exact depth of 0.115 in. as measured on the index of the cross-slide. While the work is still mounted in the chuck, the collar can in the same way be indexed for the two attachment screws, the cross centre-line being scribed with a lathe tool set at centre height.

If the keyways have been accurately machined in both the spindle and the drive collar, no difficulty will be experienced in fitting the keys.

datum surfaces the two shaft centres were marked-out. The bore for the bracket arm was next drilled and reamed to size; following this, the casting was mounted on an angle plate attached to the lathe faceplate and the bore to receive the jockey spindle was machined exactly at right-angles to the previous bore. If desired, the ends and faces of the small bracket can be machined with the casting mounted on a stub mandrel.

The jockey pulley spindle, after being turned to size and lapped true, is secured in its bracket

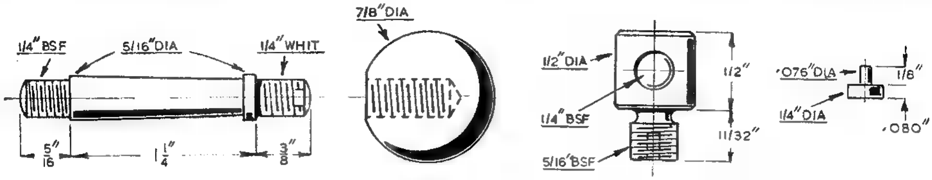


Fig. 10

The material used to make the keys was a strip of flat, ground tool-steel some 2-thousandths of an inch thicker than the width of the keyways; in fact, the cutter was in the first instance ground to suit the thickness of this material.

A piece of this steel was rubbed on a file and checked with the micrometer until it was a firm push fit in the collar keyways and at the same time a sliding fit in the spindle.

Now, all the dimensions for the keys are known; for both the keyways themselves and the recess for the heads of the keys have been exactly machined. The keys can, therefore, be filed to size by using micrometer measurements, but the depth of the keys is reduced by 5-thousandths of an inch to ensure that they do not bottom in the spindle keyways. When the keys had been formed in this way, it was found that they fitted perfectly and no additional hand fitting was required.

The Jockey Pulley Assembly

As has already been mentioned, the arm carrying the jockey pulley bracket was screwed in place in the headstock casting, and a grub-screw was fitted for further security. In addition, as shown in Fig. 8, a flat was formed on the shaft by a milling operation in the lathe; this ensures that the jockey pulleys are brought correctly into line when the bracket clamp-screw is tightened.

The bracket carrying the spindle on which the jockey pulleys run was faced on two sides by gripping it in the four-jaw chuck. From these

by means of two 2-B.A. Allen grub-screws; these can be seen in the photograph Fig. 9, as well as the form of ball-ended clamp-screw fitted.

The dimensions of this bracket clamp-screw are given in the working drawings in Fig. 10, and it will be noticed that a brass pad-piece is fitted to the end of the screw to protect the flat on the bracket arm from injury. The retaining collars can be fixed to the jockey pulley spindle either in the manner shown in the blue print or, if preferred, grub-screws, as illustrated in the photograph, can be fitted for this purpose.

The jockey pulleys themselves present no machining difficulties, for the initial turning can be carried out with the casting gripped in the chuck by its central boss, and the belt-groove is machined by mounting the pulley on a mandrel.

The bore is finally lapped to a close running fit on the spindle.

When the complete machine has been assembled, it should be run for a time, preferably at a low speed, before being put into ordinary use. During this running-in process, the spindle should be withdrawn from time to time for cleaning and applying fresh oil; in this way, any remaining lapping compound or metal particles formed while running will be removed before damage is done. At the same time, any obvious high spots on the spindle or keys should be carefully reduced by using a fine oilstone slip.

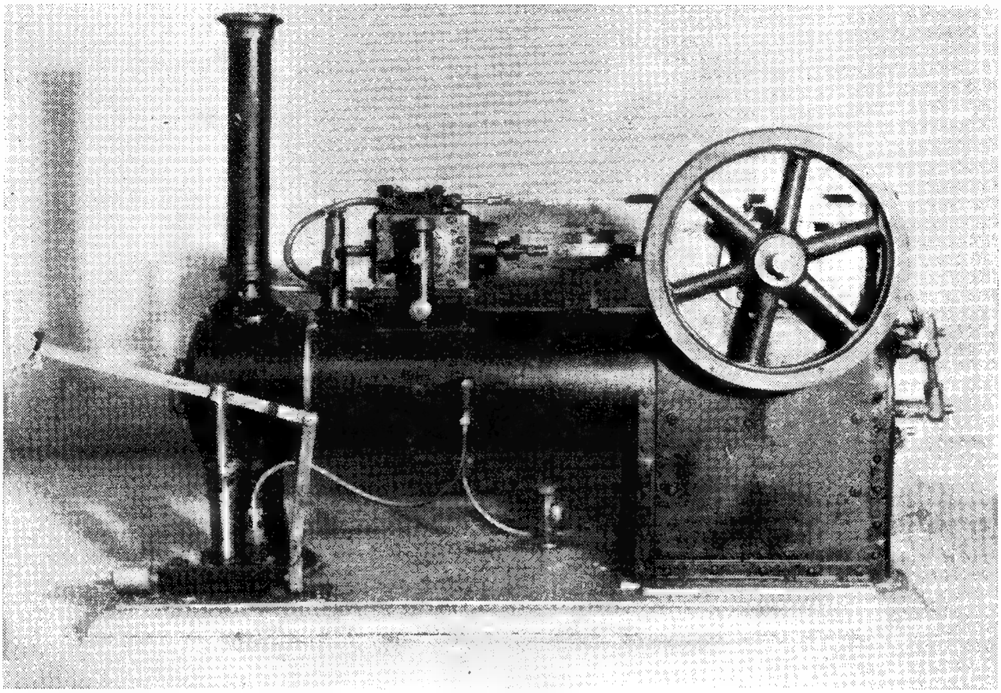
(*To be continued*)

Novices' Corner

(*Continued from page* 475)

larities on the surface of the work, it is usually advisable to insert a sheet of paper or a piece of thin card between the work and bolting surface of the slide. Should the bolting surface of the work not be flat, it is quite possible that the part will be distorted when clamped in place, so that, after the clamping pressure has been relieved, the work will return to its original form and the surfaces that have been machined will no longer be accurate. Although this applies more particularly to slender work, packings should, nevertheless, always be introduced to give the part an even bearing on the bolting surface of the cross-slide or angle-plate. On the other hand, if a rigid casting, having an irregular surface, is bolted to a slide lacking rigidity, the slide itself may be distorted and its free movement thereby impaired.

A Model Overtype Engine by H. E. Rendall



THE engine shown in the accompanying photograph, cannot claim to be a model of any particular prototype. In fact, it was never intended to be, but my friend T.S. designed it to illustrate his idea of the way in which a handsome and efficient steam engine might be constructed. T.S. is not ■ keen draughtsman and so the engine was built without drawings. This is usually rather a risky proceeding, but provided one has a good power of visualisation and knows one's job, it can be done. Anyhow, I do not remember that we got into difficulties in dispensing with drawings.

I first met T.S. some time before the war, when the engine had been begun and the boiler casing, with a small internal pot boiler, had already been made. T.S. had not much in the way of workshop equipment and as we became friendly, I suggested that the engine be brought along to my workshop and that we should work together on it one evening per week. Someone, who had bodged a set of " Fayette " cylinder castings, gave the remains to T.S., and fortunately we found sufficient metal left for ■ slightly oversize cylinder bore, and the rest of the cylinder was finished to " L.B.S.C.'s " " Fayette " specification. Mrs. T.S. picked up in the road a large lump of cast-iron, which T.S. filed up for ■ cylinder saddle and made a fine job of it, too. Well, the engine grew slowly, persistently and always pleasantly, and we gave it its first trial, just before the outbreak of war, from my test boiler. When it was possible to take up work again after the war, we ran the engine off its own small pot boiler, but as the feed pump had not been completed, the water ran low and an " L.B.S.C. " axle-dodger burner completely did the boiler in. I then suggested that ■ coal-fired locomotive boiler might be fitted inside the original casing. To this T.S. agreed and eventually a boiler to my design was completed. Frankly, I admit that it was an error on my part to fit it with $\frac{5}{16}$ in. fire-tubes ; $\frac{3}{8}$ in. would have been much better. The boiler barrel is rather long and to raise steam we usually pull out the grate and put in ■ gas burner until the first 20 lb. of steam are raised, but the gas cannot be turned on fully until the blower is going. We tried running it on charcoal, but it burnt up straight away, and did not make much steam. House coal burns all right, but the tubes soon become clogged with ■ tarry deposit. As T.S. is ■ keen locomotive fan, locomotive practice has been followed as far as possible throughout the engine. Steam from the boiler is collected in ■ small turret with the safety-valve on top and main steam pipe at the side. The throttle-valve is on top of the cylinder, and is of the piston-valve type, but it is not very sensitive. I deeply regret that no spear-head superheater was fitted, as I thought that the heat of the boiler would keep the cylinder hot, but this has not quite worked out in practice and there is ■ lot of condensed water to be got rid of on starting up.

*TWIN SISTERS

by J. I. Austen-Walton

Two 5-in. gauge locomotives, exactly alike externally, but very different internally

AFTER having cleared up all the little details of the brake gear, and, with a distinct air of finality, stated that "That's that," I was quite a bit shocked to find that one of the most glaring errors was still left standing, and elementary mechanics too! It was then too late to get the thing corrected before going to print, so I had to wait for the storm to break; and break it *did*!

I had a good many very kind letters from just interested readers and experts alike, many of them accompanied by carefully drawn-out diagrams showing that, although the system given *compensated* all right, it failed to give equal pressure on all six brake blocks.

The correction is simple enough, and will not entail scrapping anything other than the rear flat link with the three holes in it. This should be made up again, but with $\frac{3}{8}$ in. centres for one pair of holes, and $\frac{3}{4}$ in. centres for the other spacing. The rod forks go into the $\frac{3}{8}$ in. spaced holes, leaving the longer arm to pick up on the fitting on the rear stretcher. By doing this, we share out the brake loading in the proportion of 2 to 3, thus taking one third of the applied effort for the trailing wheel brakes, and passing on the remaining two thirds to be shared equally between the driving and leading brakes. I hope I have made this sufficiently clear.

Another question has been put to me in connection with return springs for the brake system, which is always rather difficult with the the loose linkage found with the compensating gear.

You cannot fit one return spring up at the front end of the engine, with the idea of pulling all the brakes off together; you will find that the slack motion is taken up unevenly, causing some brake shoes to move away from the wheels, whilst others are caused to rub even more. A very experienced and skilled locomotive builder told me he always fits coil springs round the top hinge-pins of the hangers themselves—an ideal arrangement if you have the room to do it, but unfortunately out of the question with our job. He also advocates the use of tiny coil-springs in the place of stop-pegs in the brake shoes—another sound idea, and one that readers might care to adopt.

As I think I told you, my own set of brake gear is now finished, and I am very satisfied with its working. I had noticed that, when the brake pressure was released, the shoes did not come clear away. Everything is quite free and easy in working, but the position of the centre of gravity of the shoes, arms and stretchers is such as to prevent their falling away to a natural free position.

**Continued from page* 367 *"M.E." March* 16, 1950.

True to Type

Now this is exactly what happens on the prototype, and I have been to a lot of trouble to find out. The friction caused by the shoes being left to trail lightly on the wheels could hardly be calculated, and on my own engine the effect is just the same; it is possible to *hear* the shoes sliding gently over the wheel treads, but with the freedom of roller bearings, you can spin the wheels with as much ease as you can without the brakes in place.

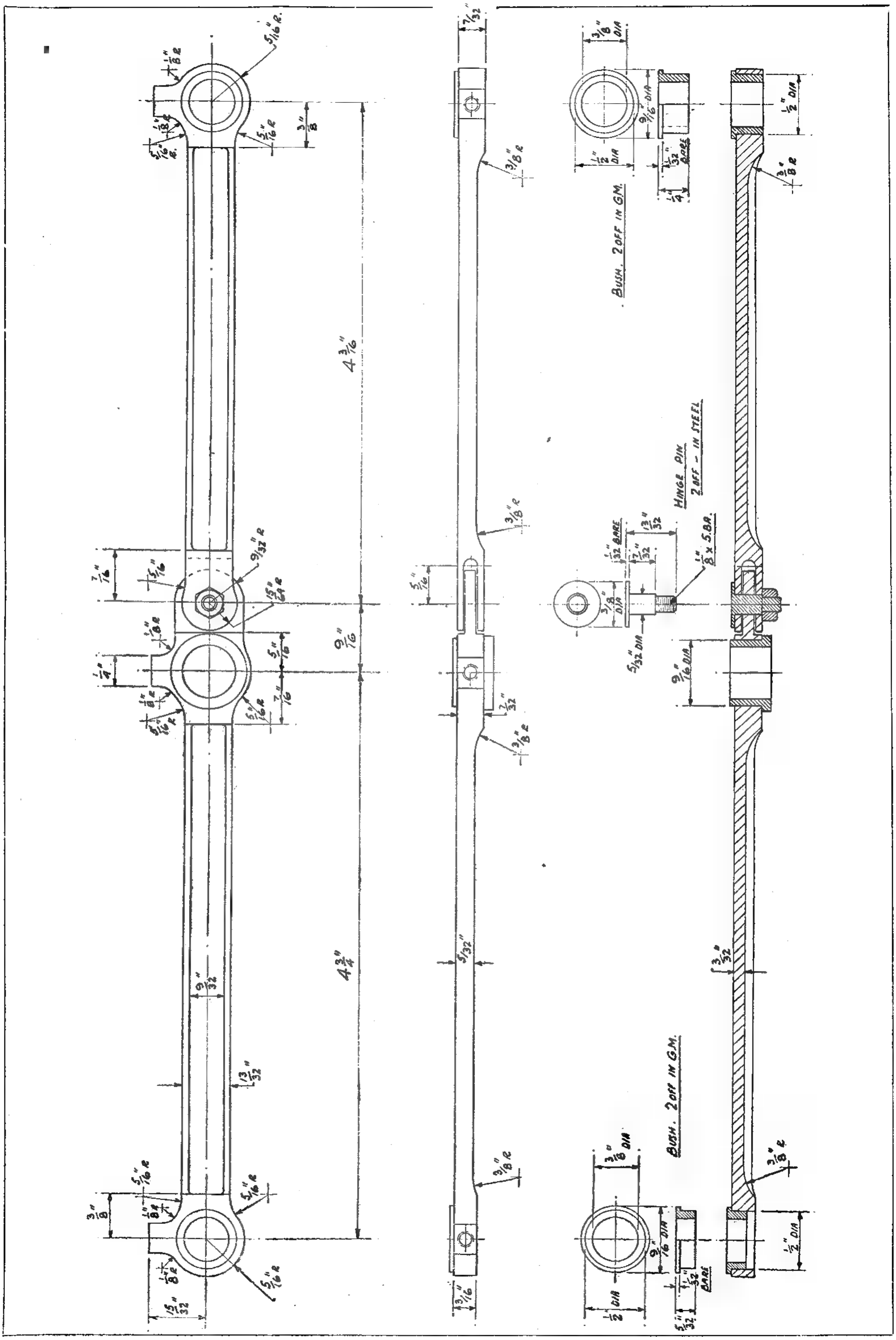
I have found the need for a spring to return the actual brake cylinder to its free position as there is distinct friction to overcome; and later when the engine is in use, and some condensate is left in the cylinder, a positive return will be needed to expel the water. I have fitted another crank arm to the brake shaft, engaging at its free end another fork and rod. The rod passes through a hole in a tiny bracket riveted to the underside of the diaphragm, and a coil-spring is interposed between the bracket and a stop collar behind the fork, and sliding on the rod. I will give a sketch of these parts—perhaps in the next instalment; they can be made up quite easily in a matter of half an hour at the most. Meanwhile, I shall continue to try to find a simple form of return spring that can be added to the linkage without further alteration, just in case the trailing shoe case offends some of the present builders.

Coupling-rods

Here we are at the first stage of the motion work, and with much of the real interest (and hard work) before us.

The drawing specifies stainless, high tensile, or high carbon steel. This quite naturally includes cast steel which, left in its natural and unhardened condition, is one of the very finest materials to use for motion-work. I know it has no rust-resisting qualities, but for its sheer strength and ability to take a fine finish, it is quite unmatched. Cast steel files well, and never picks up with the file, and, if you want to dodge a certain amount of heavy filing, you can go to the grindstone to reduce much of the surplus material. The grindstone will not "load" with this steel, and will not be harmed by being so used.

Why am I so insistent about the use of a material superior to ordinary mild-steel? Take a look at the drawing, and note how it is proportioned to scale. These parts made in mild-steel would quite definitely be on the weak side, so if you still want to use mild-steel, you will have to thicken up everything shown by about $\frac{1}{16}$ in., especially round the "eyes" of the rods. The shell of the rod with the bush removed *does* look quite slender, but made in the correct


BUSH. 2 OFF IN G.M.
HINGE PIN 2 OFF - IN STEEL
1/8" x 5 B.A.
BUSH. 2 OFF IN G.M.

material it will have about four times the required strength for the maximum loading. What is this maximum loading, in terms that anyone can understand? It is the force required to slip the wheels of the fully-loaded engine when standing on well-sanded rails; there can be no greater resistance than this, unless you put all brakes hard on at the same time, and open the regulator wide, and even *this* case has been calculated and leaves a good margin of safety.

Before cutting up any material, study the drawing carefully. You will notice that one alternative is given, that is for the knuckle-joint behind the driving wheel eye. The scrap view shows a simple type of universal joint, similar to that fitted on the prototype and used to accommodate the extra long float of the trailing axle fitted with "Cartazzi" axleboxes. On our job, we need a certain amount of "float" for easy working conditions, though not as much as would be required on the big engine. You will see that the tongue of the main rod is quite thin, but much wider than the fork that embraces it; that is where the strength is restored to the former part, and what cannot be provided in thickness is made up in width.

You must realise also that, however, carefully you make up the rods and match the working centres, you will not be able to use close fits. The independent working of the springs will lengthen or shorten the actual working centres of the rods, so that you will be forced to provide quite slack bearings at both the leading and trailing eyes. This is probably one of the weakest mechanical features of the steam locomotive, but one that is quite incurable in its present and known form.

Marking Out

Having studied the drawing, you will have noticed that the backs of the rods are quite flat; this is a big departure from the full-size job, which has further fluting and width reduction carried out in conformance with the fronts; but in our job we have a chance to incorporate strength and stiffness by leaving material in place, and keeping the proportions and looks of the job in the true scale required.

The first thing to do is to prepare the back of the bar. This should be clean and quite flat, though not necessarily super-finished. If you have bought black bar material of $\frac{5}{16}$ in. thickness, and have good machining facilities, then make use of them by taking a slight cut over the back surface, under $\frac{1}{16}$ in. if possible, or just enough to clean out surface blemishes; this is where the friend of a friend with a surface grinder at the works, has hats raised to him for a few days.

Now remove the scale the other side, and prepare with marking fluid or white paint, and allow to dry. When you come to putting in the actual working centres, check up carefully on the engine wheel centres; it is not a hard job to read these dimensions with the aid of a good, clean steel rule, and no more difficult to mark off the same centres on the rods.

If you feel that for reasons of bad eyesight, bad lighting or too many late nights, you cannot guarantee to get these centres put in to anything nearer than the odd 1/32 in., then it would be a good thing to make up a simple jig for the job.

When you made the axles you were told to drill a $\frac{1}{8}$-in. hole a little way up the ends, past the chamfer of the centring drill, and this is where the mysterious drillings are put to use.

Take a piece of steel strip of about $\frac{1}{2}$ in. × $\frac{1}{8}$ in. or a little stouter, and about $\frac{1}{2}$ in. longer than the wheel centres. Drill a hole in one extreme end, and fit a $\frac{1}{8}$ in. diameter peg, projecting about $\frac{3}{16}$ in. from one side. Turn up another $\frac{1}{8}$ in. peg, shouldered down to a small thread and leaving about $\frac{3}{16}$ in. plain portion. Drill a hole in the other end of the rod to take the thread diameter, and open the hole to a slot both ways in the length of the rod—that is, above and below the theoretical wheel centres dimension. Push the two pegs into two adjoining wheel centres, or axle centres, put a nut on the threaded back part of the movable peg, and tighten up. When you pull out the bar and pegs, you will have the true centres for the coupling-rod. When you come to the actual drilling of the rod, drill a $\frac{1}{8}$-in. hole through the driving-wheel eye first, after having marked off (as near as you can) the other hole. Drill this hole to about 3/32 in., opening it up with a needle file until the jig with its two pegs will just push in; you then will have two pilot-holes at the correct centres. It is getting these pilot-holes right that is half the battle, and well-ground drills of the larger sizes will usually follow the pilot with reasonable accuracy.

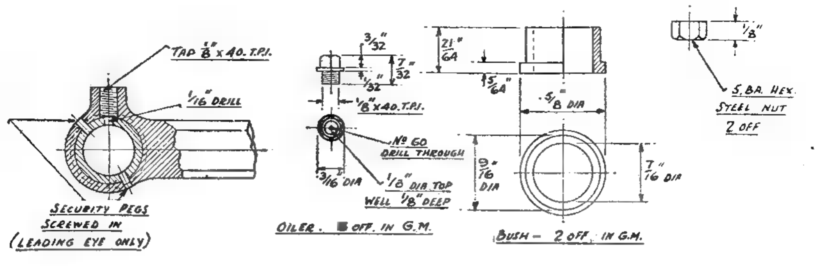
There are, of course, other and more advanced methods of matching up holes accurately, including boring the holes in the lathe or vertical miller, or by making use of the toolmakers "button"; but it is the man with very little equipment I am now trying to help. After all, we know that the finished bushes will have to have anything up to a 1/64 in. slack or elongation ultimately, so this is not a case where pin-point accuracy will be of much use to you.

Whilst talking of centres, I would remind readers that the short knuckle centre of $\frac{9}{16}$ in. is of as much importance as the other leading centres. In *itself* it might not matter, but as it makes up part of the driving to trailing wheel centres, it is vital to the total or added dimension with the remaining section of the rod. If, for example, you found you had made a slight mistake, and the $\frac{9}{16}$ in. dimension had become longer by a 1/64 in. in the process of drilling, you could still knock off the offending extra from the dimension of the rest of the rod, and so keep the working centres correct.

Bushes

The bushing of the rods is quite a simple job; but you must realise that, owing to the slender proportions of the metal round the eye of the bearing, forced fits must not be ruthless. In the case of the leading bearing, due to shortness of space for clearance purposes, the bearing has to be very narrow indeed. You will recall the special bolt fitting made up for the leading crank fitting, which has a form of captive washer head only $\frac{1}{16}$ in. thick. This must fit flush inside the eye of the bearing, and close to the face of the bush inside, and there can be nothing left projecting beyond the face of the rod itself.

That is why security pegs have been put in through the side, just in case the eye gets knocked about ■ bit, or the bush works or shrinks, or gets loose. This shortage of space is ■ real nuisance in this instance, just as it is in practically all small locomotives; but to cheat the clearances by



2 SETS OFF – HANDED (LEFT HAND SHOWN)

IN STAINLESS, HIGH TENSILE OR HIGH CARBON STEEL

spreading out other working centres is only to court troubles later on, and this is usually where the first hint of clumsiness creeps in; it is insidious at first, but growing all the time and until you can see that, somewhere, something is out of proportion. As for the wearing qualities of such ■ narrow bearing, I am not in the least apprehensive. If, after a very long period of service you find excessive slack has developed at this point, it is not a difficult part to replace, and I venture to suggest that if the crank-pin has been well finished, and the bush is made from ■ good quality of gunmetal or phosphor-bronze, it will, in all probability, never need replacement.

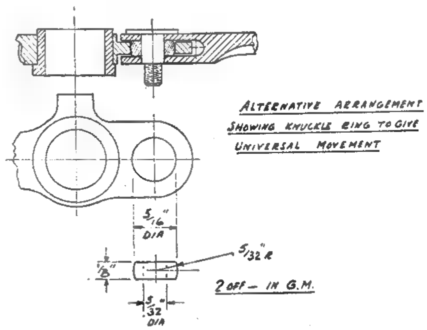
Fluting

As quite ■ number of the L.M.S. lcoomotives do not have fluted coupling-rods, I feel that builders of "Minor" might be let off this operation entirely. I would certainly prefer to see plain rods rather than clumsy attempts to carry out fluting with the aid of an end-mill; this method of removing metal is very convenient as such, and anyone who cares to hand-finish the ends of the flutes in order to get the outsweep in the proper form, can do so. It is quite possible to do this with the aid of a small chisel and a rifling file or two, but it is not for inexperienced hands.

"Major" must, of course, have the fluting as shown; but on the coupling-rods this can be carried out on any machine that gives a travel of about 4 in. Using ■ "Woodruff" type of cutter, and with the lathe fixed up with a vertical slide, it is just too easy, especially as the flutes are straight. If it had been the connecting-rod with its taper flute, it would be a bit more complicated; but we will not think about that yet.

Assuming that your cross-slide has the desired travel, you would fit the vertical slide on with its table or vice face towards the chuck. Find ■ piece of steel bar, about 1½ in. wide × ⅜ in. thick and hold it in the vice, so that ■ ledge of about ⅜ in. projects. This will carry the rods, face upwards, so that they can be brought up to an end-mill, running in the chuck, to machine the face relief on the rod, followed by a "Woodruff" cutter to make the flutes, both at one setting. The rods would be fixed down to the ledge by means of bolts passed through the drilled ends of the rods. A similar set-up could be used to hold the rods for the milling of the fork and the tongue. You will notice that on this engine, the tongue is milled with straight shoulders instead of the matching socket that one usually associates with this job; this is done to allow the fork completely free movement in its capacity of part-universal joint. Frankly, I do not like the look of it as well as I like the neat socket type; but it is on the prototype, and like that it must be.

The procedure then to follow is this; prepare the steel, clean up and prepare the other side, mark out and cut out the profile, drill the pilot holes, check for centres, and drill or bore to size, mount up for face relief and fluting, reduce the raised faces to finished thickness and press in the bushes. At this stage you will need to try



the rods for working on the wheels, and there is just one point to watch, not only for this, but also for the wheel positions when you make the little centres jig mentioned earlier on.

Put the chassis on its back and notice the positions of the wheels and axles in their horn cheeks. In all probability, the springs will hold these down to their bottom limit, but as the trailing axle has ■ slightly longer travel in the cheeks, the wheel will stand out beyond the line of the other two. By means of blocks or small metal wedges

between the axleboxes and the "keeps," level off the treads of all wheels with a straight edge. Now you can try the rods in place; they should run without any binding, or without any tendency for one or more of the wheels to "jump" when passing a certain position.

In all probability, you will find that everything is in order; but you must not leave it at that. Remove the wedges or blocks from under the trailing wheel axleboxes, and notice the difference.

It will now be necessary to elongate the affected bearings to allow for the extra length of centres, and this is best done by making up a very tiny bearing scraper, much on the lines of the normal bearing scraper used for whitemetal car bearings. I know a round file will remove the metal much more quickly, but it hardly leaves a good bearing surface; take off some of the metal with a file if you like, removing the last few scrapings with the more refined tool. When you can once more revolve the wheels without binding, etc., leave off, and perform the same antics with the leading axle, but this time putting a $\frac{3}{16}$-in. packing piece between the bottom of the axlebox and the wide keep, which will give you about as much unequal wheel movement as you are ever likely to meet.

I suggest the above procedure in preference to the drilling or boring of oversize bushes which, although it fills the bill, leaves you with a lot of slop all round intsead of slop just where you need it.

Now you can set about finishing off the rods altogether. The flutes may be a little rough inside, in spite of all the care you took with them, and this is where a rifling file comes in so usefully; an evening spent with this will make a world of difference to the look of the rods, but please do not be tempted to lash about with lots and lots of emery-cloth; I do not know what it is, but you can always tell where this has been used, even if the edges have *not* been rounded off here and there.

(To be continued)

Height Gauge with Adjustable Base

WHEN making the crankshaft of a triple expansion engine I realised how much easier it would be if one's zero line corresponded with a definite reading on a gauge.

If the scriber were at, say, 1 in., then all the measurements were quite easy to read. Of course, one could pack the base of the gauge, but it seemed simpler to make the base adjustable. This is done by a fine screw-thread, which is a good fit. Within the base is a strong spring to take up the slack. When the instrument is adjusted, the screw is locked in position by the small set-screw *A*, which has a leather pad to protect the thread.

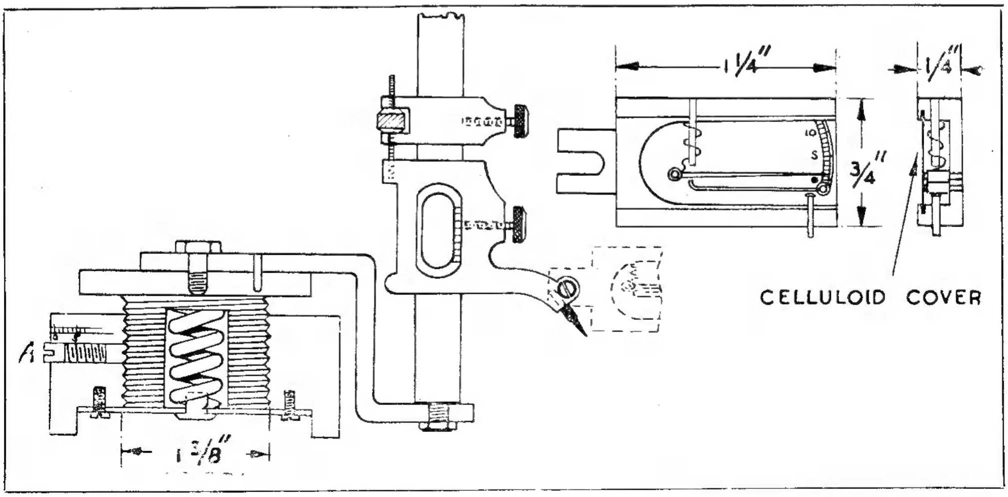
The caliper is an old one of which the jaws were no longer accurate, but that does not affect the reading on the scale.

A "Clock" Attachment

The "clock" was made so as to get accurate readings on a sine bar; it is quite simple to make and reads to half a thousandth of an inch. The celluloid cover serves the double purpose of keeping the arms in position as well as excluding the dust.

The body is a piece of milled out aluminium scrap, the only difficulty being the spring. I finally found that a strand of lighting flex made a very light spring and yet was strong enough to return the needle to zero. The "clock" is very light and small, measuring only $1\frac{1}{4}$ in. by $\frac{3}{4}$ in. by $\frac{1}{4}$ in. and is fitted as shown in the illustration.

—H. STOCKER HARRIS



Queries and Replies

Enquiries from readers, either on technical matters directly connected with model engineering, or referring to supplies or trade services, are dealt with in this department. Each letter must be accompanied by a stamped, addressed envelope, and addressed : " Queries Dept.," THE MODEL ENGINEER, 23, Great Queen Street, London, W.C.2.

Queries of a practical character, within the scope of this journal, and capable of being dealt with in a brief reply, will be answered free of charge.

More involved technical queries, requiring special investigation or research, will be dealt with according to their general interest to readers, possibly by a short explanatory article in an early issue. In some cases, the letters may be published, inviting the assistance of other readers.

Where the technical information required involves the services of an outside specialist or consultant, a fee may be charged depending upon the time and trouble involved. The amount estimated will be quoted before dealing with the query.

Only one general subject can be dealt with in a single query ; but subdivision of its details into not more than five separate questions is permissible. In no case can purely hypothetical queries, such as examination questions, be considered as within the scope of this service.

No. 9785.—Miniature Auto-cycle Drive
S.V. (Workington)

Q.—I am building a runabout of the " Corgi " type for personal conveyance to business and would appreciate some advice on the engine unit. Would an engine of 30 c.c. capacity, suitably geared, be capable of driving such a machine over fairly hilly roads at speeds of around 15-20 m.p.h. I would prefer to build the Seal 30 c.c. 4-cylinder type, and request your opinion as to the highest capacity to which this design could be increased, using 30 c.c. version castings. Can you advise me if the scaling up of the Seal to 60 c.c. is just a matter of proportional increase in all dimensions. Should this not be sufficiently powerful, could you recommend a transverse twin 2-stroke.

R.—A 30 c.c. engine would drive a miniature auto-cycle or motor cycle with reasonable efficiency, and probably produce a speed of at least 15 m.p.h. on the level, but we should be very much inclined to recommend a somewhat higher engine capacity if only for the sake of providing a good mechanical margin. A small 4-cylinder engine would undoubtedly provide delightfully smooth running, but the disadvantage of such an engine would be extremely small working parts, which might be inclined to wear out rather rapidly, and produce a lot of mechanical noise and loss of efficiency. It would be possible to scale up the Seal design to 60 c.c. without making much difference in the proportions of various parts, but if the engine is intended for continuous running, we should certainly recommend that, at least, the crankshaft should be stiffened up, and its bearing surfaces increased everywhere.

With regard to the suggestion of a transverse twin 2-stroke, this would make quite a well-balanced and smooth-running engine, but in so small a size, we are inclined to think that a single-cylinder engine would be better for the purpose.

No. 9787.—Balancing Engine
L.W. (Derby)

Q.—I am building an 80 c.c. two-stroke petrol engine, single-cylinder, and I should be very grateful if you would inform me how to get the best possible balance. Would the " Atomag Minor " magneto be suitable for this engine ?

R.—The usual practice in balancing a single-cylinder engine is to add counterweights to the crank, sufficient to balance all the rotating weight, and approximately half the reciprocating weight of the moving parts. The crank pin, big-end bearing and lower half of the connecting-rod are usually taken as rotating weight, and the upper half of rod, piston rings and gudgeon-pin are taken as reciprocating weight. The balancing process usually consists of setting the complete crank shaft on levelled knife edges, so that it can roll freely, and hanging the computed weight on the crank pin. The counter-weight should then be adjusted until it is found to balance this weight exactly. It should be noted that this method of balancing represents only a compromise, as a single-cylinder engine of the normal type cannot be perfectly balanced, and under certain circumstances, slightly more or less than the proportion of the reciprocating weight stated may have to be balanced out.

The " Atomag Minor " magneto would be quite suitable for furnishing ignition for an 80 c.c., engine, but in view of the large size of the engine. it would be possible to obtain a magneto of this type used on auto-cycles engines for the purpose.

No. 9788.—Surplus Master Contactor Clock Unit
S.A.W. (Newport)

Q.—I recently purchased a master clock unit and I should be pleased to know if this is suitable for conversion to household use.

R.—We are of the opinion that the master contactor unit is not suitable for adaptation as a household clock. Its intended purpose is to furnish electrical impulses at half-second intervals to some form of time switch, or similar chronographic instrument. The clockwork mechanism of the contactor only works for approximately eight hours at one wind, and there is no convenient wheel or spindle in the mechanism which could be used for driving the hands and motion work which would be required to indicate time in the normal way.

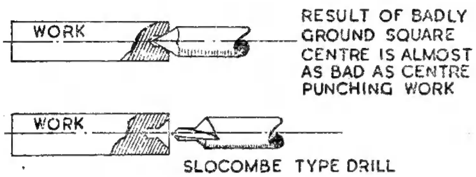
PRACTICAL LETTERS

Lathe Centres

DEAR SIR,—The article, "Care of Lathe Centres" by W. T. Saunders was, in my opinion, very misleading, especially to the beginner.

While I agree that one cannot be too careful with centres, I would like to point out the flaws in the article.

Mr. Saunders states that a centre should never be knocked into place by a hammer, etc., but with a piece of wood. In my experience all that is necessary to firmly fix a centre in position is a sharp push. A second point that I would like to make is that if a square centre is employed,



great care should be taken to grind it to an angle of 60 deg. otherwise a bad bearing surface will be the result. (See sketch.) I am also greatly surprised that no mention was made of the use of Slocombe type centre drill which drills a small clearance hole for the point of the centre and also forms a correct 60 deg. bearing in one operation. (See sketch.)

Finally, I should like to suggest that where the pocket will allow it, the purchase of a revolving or "running" centre will never be regretted.

Yours faithfully,

South Woodham. V. SEARLE (TURNER).

International Racing

DEAR SIR,—The discussions under the above heading in these columns must have been of interest to many, particularly those closely concerned in model racing, and I for one would like to thank THE MODEL ENGINEER for the manner in which they have been conducted.

We do not, however, appear to have arrived at any decision or particular recommendations as yet, as far as international events are concerned, but it is fairly apparent that the root of the whole argument revolves round the question of running "purchased" and "home-made" models in the same class.

I have read in one model paper that there is very much more to breaking model car speed records or winning races in this country than using a screwdriver to open a box containing a purchased model! As I have held that this statement is not necessarily true, may I submit the following *facts* to support my argument, and to illustrate the tremendous gulf that exists between the "home-made" and "commercial" engines.

Although I love all types of working models, I have spent the last *ten years* in the pursuit of reliability and m.p.h. as applied to model cars alone, and highly fascinating the subject has been and still is, but it need hardly be added that it also involved the expenditure of much mental and physical toil.

It has also been my lot for Fate to allow me a certain measure of success in terms of "results," and at the present time my car *Topsy* holds the British speed record at 109.8 m.p.h.

Not wishing to endanger the engine by even further development to which the now "old-fashioned" design may not be equal, I added to my stable some months ago a car which I intend to use as a "guinea-pig," on which I could conduct experiments with far less concern as to their possible disastrous [?] outcome than I could on the one on which I had spent so much time.

Very recently I ran this car for the first time at a model car meeting in Liverpool, when it promptly equalled the British Open record of 113.9 m.p.h. already held by an American car and engine. The track was very greasy and smaller in diameter than standard.

The credit to myself is obviously *nil* and I certainly do not pretend it to be otherwise, but having had the experience of "wiping the floor" with myself so to speak, by the sole aid of a purchased car, to the performance of which I contributed exactly *nothing*, it has made me realise even more—if possible—how grossly unfair it is to the owner/builder to race these two types in the same class with no distinction between them.

To my sorrow, the M.C.A. recently rejected a proposal to make any definite distinction between the two, though they did eventually decide to issue a recommendation on the matter, which I sincerely hope clubs will not ignore. Perhaps the foregoing may serve as a guide to the situation!

For the time being the M.C.A. recommend a division into "British" and "Open" classes where possible—the former to include *any* British made products, home-made or otherwise.

I should very much like to support Mr. Westbury's statements that there is not one jot of personal animosity in these arguments, but that it is simply a question of the principles involved.

Yours faithfully,

Stoke-on-Trent. F. G. BUCK.

Efficiency = 100 per cent.

DEAR SIR,—There is really no difficulty about the performance of my 0-6-0 locomotive; Mr. Bristow has taken a calculated figure as an actual reading, and, of course, this has led to a wrong deduction.

I do not know, of course, what the actual M.E.P. was. My data was an observed pull of 7 lb. at $6\frac{1}{2}$ m.p.h., which is about $\frac{1}{8}$ h.p., also that the steam-chest pressure was 140 lb. and cut-off 70 per cent. All that Mr. Harris did was to calculate that $\frac{1}{8}$ h.p. at $6\frac{1}{2}$ m.p.h. represented an M.E.P. of 65 lb., so, of course, if Mr. Bristow uses this 65 lb. M.E.P. in the P.L.A.N. formula he will, of necessity, arrive back at the $\frac{1}{8}$ h.p. The actual cylinder h.p. and with it the M.E.P., must, of necessity, be greater than this; first, the locomotive will require about 1/10 of the d.b.h.p. to move itself; this will increase the

M.E.P. to 73 lb., and if we assume a mechanica efficiency of 85 per cent., this would involve an actual M.E.P. of 85 lb., which seems reasonable for 140 lb. steam-chest pressure at 70 per cent. cut-off. If the mechanical efficiency is less than 85 per cent. the M.E.P. will, of course, be higher than 85 lb., but it cannot be much higher with only 140 lb. in the steam-chest and such small cylinders.

While on this matter of cylinder efficiency, I should like to put in a few remarks about that much misunderstood subject, compression. In a steam engine cylinder the compression period has no place in the heat cycle, it is primarily a dead loss; but in actual practice some is needed for smooth mechanical working and also to avoid the total loss of the steam in the clearance space.

An ordinary slide- or piston valve with steam lap and driven by a normal type of valve-gear must have a compression period, which becomes greater as the gear is notched up. Its timing can be controlled to a limited extent by varying the ratio of steam lap to lead and by the provision of exhaust lap or clearance, but its presence is an inescapable fact. However, as we cannot have a cylinder without clearance, we need some compression, and on the whole, things work out pretty well on a normal locomotive.

In a cylinder without any compression, the whole of the steam in the clearance space will be lost each stroke, but there will be no loss due to back pressure. If, on the other hand, the compression be carried up to the steam-chest pressure, then none of the clearance steam will be lost; but there will be considerable loss due to back pressure. The ideal condition is somewhere between these two and can be determined exactly; but if the clearance steam be compressed to about half the steam-chest pressure, it is as near as one needs get. We have very limited control of the compression point, and the steam-chest pressure varies.

Yours faithfully,
Bexhill-on-Sea. C. M. KEILLER.
M.I.Mech.E.

Frequency Monitoring

DEAR SIR,—The Radio Controlled Models Society is seriously perturbed at the number of radio controlled models taking part in field events at which no official frequency monitoring is arranged. At these events, over which the society has no jurisdiction, models have been observed operating outside the frequency bands allotted by the Postmaster-General for that purpose. It is of vital importance that these concessions are not abused, otherwise they may be withdrawn, and radio-control enthusiasts may find themselves forced to operate under the more stringent conditions imposed in other countries.

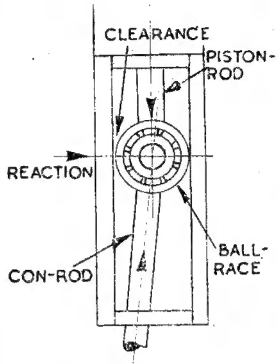
Monitoring equipment of a simple type is cheap to construct and operate, and, in the view of the Radio Controlled Models Society, is essential in any radio-controlled demonstration.

Yours faithfully,
J. HEATHTOTE.
Hon. General Secretary,
Radio Controlled Models Society.

Ball-bearing Dieblocks

DEAR SIR,—*Re* the ball-bearing dieblock discussed on page 694 in the December 1st, 1949, issue of THE MODEL ENGINEER.

In all bearings and slides there must be a clearance; therefore the ball-race cannot touch both sides of the guide at once, so it rolls as intended. As to your point about line contact all ball-bearing and roller-bearings have the same feature. True, both races are hardened.



I have designed and built a $1\frac{1}{8}$ in. $\times$ $1\frac{1}{2}$ in. vertical steam engine, illustrated below, with a ball-bearing cross head, the races running on slide bars as in old mill engines. The races do roll as intended, the clearance is 0.002 in. and after some use the guides are as highly polished as when made. My guides are unhardened silver-steel rod, machined flat.

Yours faithfully,
Loughborough. G. WALL.